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May, 1949

FACTORS INFLUENCING SELECTION OF OPERATION FOR CARCINOMA OF THE LOWER PORTION OF COLON AND THE RECTUM

CHARLES W. MAYO, M.D.

Rochester, Minn.

THAT no region of the colon or rectum is immune to carcinoma is accepted, but opinions still vary concerning the best method of treating carcinoma of the colon or rectum regardless of the region involved. This controversy is especially great regarding treatment of malignant lesions situated in the lower part of the colon and the upper part of the rectum and it is in this region that the majority of such lesions occur.

Much work has been done over the years in an attempt to evaluate the various surgical procedures for the eradication of malignant lesions while they are still within the range of complete surgical extirpation. Complete extirpation means riddance of the primary growth and, if present, secondary growths.

All malignant lesions start small and grow large. There is a stage during which the problem of eradication would be relatively simple if the presence of the lesion could be recognized. Practically all the carcinomas of the rectum are adenocarcinomas. Most pathologists believe that they originate in the glandular elements of the intestinal mucosa and that the epithelial elements are derived from the columnar cells of the Lieberkühn follicles. It also is generally agreed that there are conditions that are precancerous and that on careful examination certain of these conditions may be found and eliminated. Although the development of carcinoma on a sessile or pedunculated polyp of the colon is not inevitable, it can and

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Division of Surgery, Mayo Clinic.

often does happen. A benign adenoma, with time and normal irritation, may develop into carcinoma. There is ample precedent for fulguration or transcolonic excision of benign adenomas. To submit a patient to a radical major surgical procedure when a comparatively simple fulguration would take care of the situation is just as much an error in judgment as to be too conservative when only an extensive resection is indicated.

Surgeons who have chosen diseases of the colon and rectum as their field of special interest are deeply concerned with the individual patient to be treated. How radical must the surgical procedure be to obtain the optimal result in the particular instance? Are extensive resection and a permanent abdominal colonic stoma necessary? Or can a comparable result be obtained with an operation in which the sphincter muscles are preserved?

For years, I could have been classed among those who were of the opinion that a loop colostomy, followed later by posterior resection, was the operation of choice for all malignant lesions in the lower portion of the colon and the rectum because combined abdominoperineal resection carried too high a mortality rate. With time and the surgical cycle, I became convinced that the combined abdominoperineal resection in two stages was the only logical operation for malignant lesions of the rectum, rectosigmoid and the lower portion of the sigmoid. Then I became convinced that the one-stage combined abdominoperineal resection was best and I still am of the opinion that if only one procedure were available with which to deal with malignant lesions in these segments of the colon and rectum, the one-stage combined abdominoperineal resection is the one of choice. However, at present I believe that there is more than one procedure from which to choose and the findings in each case should be the guide to the choice of surgical attack. The range of choice has expanded for many reasons. Chiefly, however, the antibiotics must be credited, the uses of which in the preoperative preparation of the colon are well known. The mortality rate from all types of surgical procedures on the colon has decreased with the improved control of the bacterial content of the bowel. Of great help in the selection of operations and in increasing the choice have been the careful studies on the lymphatic spread of malignant lesions of the colon and rectum. Among the most familiar contributions to this knowledge is the work of the English, namely, Cheatele, Gorden-Watson, Dukes, Gabriel, Miles, Monsarrat, Moynihan, Wilkie and others, and Americans, namely, W. J. and C. H. Mayo, Halsted, McVay, David and Gilchrist, Collier and his associates, Rankin, Glover and Waugh, Dixon, Dafoe and many others.

Many surgeons who have long since passed on, also were intensely

interested in the subject of carcinoma of the large bowel and their work and studies contributed to the understanding of malignant spread and the important part played by the lymphatics. C. H. Mayo in a paper on this subject, written and published in 1904, stated: "The last decade has marked an advance in methods derived from an analysis of the mortality and failures in the past, and the gain has resulted in the present thoroughness in surgery, and the substitution of asepsis for antisepsis. The block removal of the rectum and glands, where possible from below, and in high locations of cancer, the combined abdominal and perineal methods of removing rectum, glands and all malignant tissue, en masse, is the surgery for cancer of this region. This method is merely the application of the principles of the surgery of cancer regardless of the location, as exemplified by Halsted's operation for the removal of cancer of the breast. It is probable that the removal of cancer of the rectum in the past compares well with the removal of cancer of the breast before radical operations were made on the lymphatic system, with the exception of the former being in a more septic region. The combined abdominal and perineal method is now advocated for high rectal carcinoma by the pioneers in rectal surgery, Kocher, Kraske, Gaudier, Quenu, Trendelenburg, Abbe, Weir and numerous others." In the same paper, the one-stage combined abdominoperineal resection is described in detail and the following statement is made which relates to the synchronous combined abdominoperineal resection: "If the surgeon has a good assistant, the perineal operation, with the removal of the rectum, can be performed by him during the time the abdominal work is advancing above."

Prior to the past decade, few surgeons advocated the low one-stage anterior segmental resection and those who did were looked on with distrust. The surgeons' eyes were focused on the desirability not only of removing enough tissue above the lesion to reach the upper limits of spread in the lymphatics, which was well worked out, but also of removing enough tissue from below the growth to eradicate the retrograde or caudad and lateral lymphatic spread. The lateral and retrograde spread had not been adequately studied. The surgeon assumed that it also was extensive.

The principal contributions that have altered the attack on carcinoma of the lower portion of the sigmoid, the rectosigmoid and upper portion of the rectum in selected cases have been those that have been concerned with the intramural and extramural retrograde, lateral and upward spread of malignancy. The information gained by the meticulous search for nodes in tissue removed in the course of radical operations for carcinoma of the rectum and lower portion

of the colon, by Dukes, Gilchrist and David, Collier and others, has demonstrated that more nodes are involved than previously was believed. The number involved is in proportion to the diligence of the search. Until recently the extent of the upward or cephalad spread has been much better appreciated and has influenced the selection of operation more than the limitations of lateral and downward or retrograde extension have.

INTRAMURAL SPREAD

For many years, the relative slowness of local growth has been noted in carcinoma of the rectum. Miles, in emphasizing the slow character of surface extension, estimated that a lesion in the ampulla requires six months to travel a quarter the circumference of the bowel. He also noted that direct extension is a gradual process.

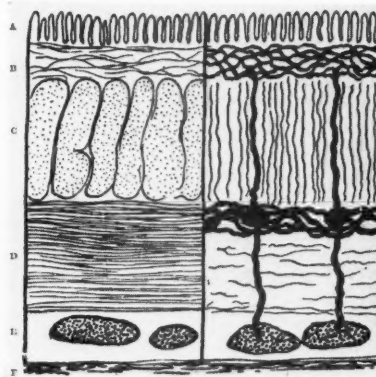


Fig. 1. Diagrammatic sketch of the intramural lymphatic drainage of the rectum. (A) Mucous layer; (B) submucous layer; (C) circular muscle; (D) longitudinal muscle; (E) anorectal node and (F) fascia propria. (From Cole, P. P.: The Intramural Spread of Rectal Carcinoma, *Brit. M. J.* 1:431-433 [Mar.] 1913. By permission of the publisher.)

After a growth has perforated the wall, the perirectal tissue is invaded, next the fascia propria is invaded, and after this, invasion of neighboring structures takes place. All investigators generally agree that attachments of these growths are inflammatory more often than they are malignant.

One of the first to point out the limitation of spread of growth beyond its microscopic edge was Cole, in 1913. He also demonstrated that the widest spread was in the longitudinal muscle coat and the cellular tissue outside it. The advance of cancer cells in the submucosal and muscular coats is slow, in spite of radial lymph channels from the submucosa through the circular and longitudinal

muscles (fig. 1). The opinion expressed for the limitation of intramural spread is that the lymphatics are arranged in a decussating arborescent pattern from the radial, collecting stems which pierce the muscular coats. One can assume from the many studies made that intramural dispersion of the malignant cell plays but a minor rôle in the demand for extensive resection.

EXTRAMURAL SPREAD

Upward or cephalad. As previously stated, the upward spread of embolic cancer cells along lymph channels to lymph nodes long has been recognized and appreciated (fig. 2a and b). Gilchrist

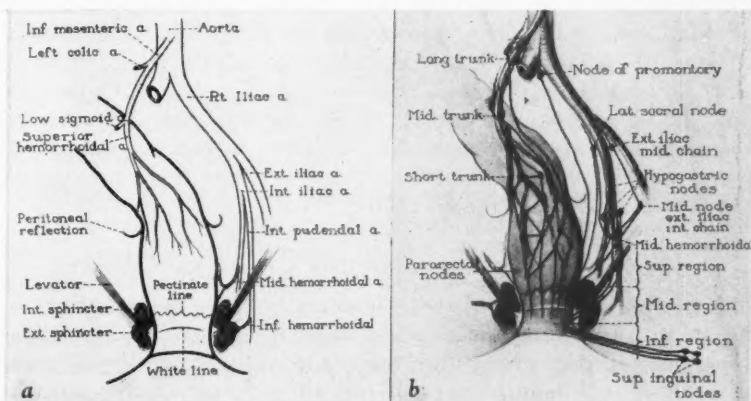


Fig. 2a. Lymph vessels which drain rectum follow the arteries shown (see fig. 2b); b, Normal lymphatic drainage of the rectum. (From Dafoe, W. A.: *The Retrograde Lymphatic Spread of Carcinoma of the Rectum Situated between the Pectinate Line and the Peritoneal Reflection—Its Influence on Surgical Procedures*, Thesis, 1946, Graduate School of the University of Minnesota. By permission of author.)

and David have brought out the mechanism of invasion and the taking over of the lymph node by the malignant process. They also explained the method by which "skip areas" or uninvolved glands can occur. Those engaged in research on the colon have often and amply justified the importance of a high resection, as exemplified by a well-done abdominal portion of the combined abdomino-perineal resection. There is no surgical argument contrary to radical consideration for the extirpation of the many glands involved in upward spread.

Lateral spread. Lateral spread does not mean spread to nodes lying on a level, next to the malignant growth itself but is reserved to describe extension to the lymph nodes along the middle hemor-

rhoidal artery after the nodes of Gerota have become involved. Gabriel, Dukes and Bussey found no evidence of lateral spread unless the nodes along the lymph vessels extending above the lesion were completely blocked. Under such circumstances lateral spread can occur and it also can come about from ulcerating lesions within 1 inch (2.5 cm.) from the mucocutaneous juncture. Gordon-Watson disposes of the subject of lateral and retrograde spread by stating that only in the rare, advanced and most exceptional case is it worthy of consideration.

Downward or retrograde spread. According to many investigators, carcinoma of the rectum does not spread downward above the pectinate line without complete blockage of the upward lymphatics. Among the investigators who have demonstrated this are McVay; Wood and Wilkie; Westhues; Gabriel, Dukes and Bussey; Gilchrist and David; Grinnell; Glover and Waugh, and Dafoe. In only 22 (2 per cent) of a total of 882 cases of carcinoma of the rectum studied by these men, did the lesion spread downward for more than 1 cm. In only 10 (1 per cent) was there retrograde spread for a distance of more than 2.5 cm.

OTHER FACTORS INFLUENCING THE CHOICE OF OPERATION

For all lesions, except those which are, without equivocation, inoperable, and those which are found early and are of a polypoid type and fall distinctly within the realm of treatment by fulguration, there is a logical choice of resection. Many factors must be considered and experience in evaluating them no doubt sways surgical judgment in favor of this or that type of procedure.

Malignant lesions less than 6 cm. from dentate margin. At present three operative approaches are used most frequently for malignant lesions situated less than 6 cm. from the dentate margin of the anus. First, because it most generally is accepted and performed, is the one-stage combined abdominoperineal resection; next, the two-stage operation of the same general type, and last, the older operation of loop colostomy followed at a later date by posterior resection. I have indicated my choice as being the one-stage combined abdominoperineal resection.

The low immediate mortality rate and the 3, 5 and 10 year results of the one-stage combined abdominoperineal resection have proved this operation worthy of its place of preference. The abdominal and perineal procedures may be accomplished synchronously if one surgeon performs the abdominal portion of the dissection and resection and another surgeon the posterior resection as soon as the abdom-

inal exploration has been performed and it has been determined that this is the operation for the individual case.

The two-stage combined abdominoperineal resection may have a place in the armamentarium of surgical procedures in this part of the bowel. Loop colostomy, followed later by posterior resection also may fall in the same class as the two-stage combined abdominoperineal resection. It is dangerous to make a statement that these two operations are outmoded and should not be used as there are always exceptional cases in which one or the other may be needed. In my experience of the last fifteen years, since I adopted the one-stage operation, however, I have found very few cases in which the one-stage abdominoperineal resection could not be performed if operation could be performed at all.

Malignant lesions 6 cm. or more from dentate margin. When carcinoma occurs at a point 6 cm. or more above the anus, there is an additional number of surgical procedures from which to select one which will fit the patient.

Babcock, Bacon and Waugh have championed the combined abdominoperineal resection with preservation of the sphincters, sometimes called the "pull-through" operation. Waugh, however, seems gradually to have swung more to the primary low anterior resection of the growths situated in the upper portion of the rectum and higher. I have observed excellent results from the "pull-through" operation as described by those who perform it, and also some results which were not good. My experience with this procedure has not satisfied me.

My choice of operations for carcinoma of the upper portion of the rectum, the rectosigmoid and the lower portion of the sigmoid at present (I have learned to qualify a statement such as this) lies between a primary anterior segmental resection and anastomosis, with or without concomitant transverse colostomy, and a one-stage combined abdominoperineal resection. I prefer to prepare all patients who have malignant lesions in this part of the colon or rectum for a one-stage combined abdominoperineal resection. At operation I proceed with the majority of the abdominal portion of the dissection used in this operation. I ligate the hemorrhoidal artery high and sever it, and select the point on the sigmoid which has an adequate blood supply for the upper end of the resection. At this point in the operation if I find that the bowel can be resected at least 2.5 cm. below the malignant growth and that an accurate anastomosis can be made without tension, I perform a primary low anterior segmental resection with end-to-end anastomosis in preference to a one-stage combined abdominoperineal resection.

The question of whether or not to perform transverse colostomy at the time of the low anterior segmental resection and anastomosis has been the subject of much discussion. Those who perform colostomy at the same time do so because they feel it is an additional safety measure and do not dare not to do so. Actually, the hospital mortality rate in the group of cases in which colostomy has been performed at the time of resection is not appreciably different from that in the group in which colostomy has not been performed (3 to 6 per cent). However, there is a distinct difference in the morbidity rates. By the end of the second month after operation when colostomy has not been performed, 99 per cent of the patients have been dismissed from the surgical service, as opposed to only 10 per cent of patients when colostomy has been performed.

On my surgical service, we do not establish a colonic stoma at the time of low anterior resection and anastomosis. Manual dilatation of the anus is done at the conclusion of the operation to prevent the retention of gas. The patient is urged to get out of bed and to become active early. A third of the patients are out of the hospital within two weeks of the date of operation.

COMMENT

In conclusion, it would appear that although many operative methods have been devised and developed for malignant lesions of the upper part of the rectum, the rectosigmoid and lower portion of the sigmoid, the low anterior segmental resection, with primary anastomosis, with or without accompanying colostomy (preferably without), has a sound basis, from the knowledge of lymphatic spread, for serious consideration as a procedure of choice in the majority of such lesions. It is a procedure that is well suited as a palliative operation in selected cases, in preference to abdominal colostomy. Any increase in risk that may attend its use as a palliative procedure is compensated for by the increase in the patient's morale.

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TUMORS OF THE NECK

SAMUEL F. MARSHALL, M.D.

and

WALTER F. BECKER, M.D.

Boston

TUMORS of the neck present a problem in differential diagnosis, and institution of early treatment is necessary especially because so many of these tumors are either primarily malignant or possess the properties of ultimately becoming malignant if not removed early by operation. The early recognition of their pathologic characteristics is imperative because their continued growth may tend to make treatment, either surgical or otherwise, a more difficult process or even impossible of obtaining a reasonable chance of cure.

That the clinical differentiation and recognition of these tumors is not always possible is well recognized and the ultimate diagnosis may be established only by surgical exploration and biopsy. If the type and frequency of neck tumors is recognized, however, a considerable percentage can be identified and the proper technical procedure applied. Unfortunately, ill-advised or incomplete surgery or irradiation treatment often so complicates the ultimate removal that surgical removal is made hazardous or at best technically extremely difficult, as so often is seen in cases of partial excision of tumors of the parotid gland.

Tumors of the neck are encountered often in a busy surgical service. Various methods of classification of these tumors have been given in a discussion of this subject, but we believe that this presentation is more significant if these tumors are arranged on a more or less pathologic basis, that is on a basis of their origin from certain anatomic structures in the neck. Any arrangement of these tumors on the basis of location, such as midline or lateral tumors, is helpful in recognition of their development, but so many tumors of similar origin arise in either location that such a listing may tend to cause some confusion. For practical purposes, most midline tumors are of thyroid origin but one may find lateral tumors of thyroid origin and again tumors may arise in either location.

In a presentation of this subject, one must necessarily restrict the discussion to the more frequently occurring tumors. For the sake of completeness, however some rarely occurring tumors are noted in the classification.

From the Department of Surgery, The Lahey Clinic, Boston, Mass.

Read before the sixteenth annual Postgraduate Surgical Assembly of The South-eastern Surgical Congress, Hollywood, Fla., April 5-8, 1948.

TUMORS OF THE NECK—CLASSIFIED BY ANATOMIC ORIGIN

- A. Lymphoid tumors—cervical node enlargements
 - 1. Acute or chronic inflammation (from tonsils, teeth, jaw)
 - 2. Infective granuloma—tuberculosis, syphilis
 - 3. Malignant lymphoma
 - Hodgkin's disease, lymphosarcoma, leukemia
 - 4. Secondary carcinoma to cervical lymph nodes
 - Lip, tongue, mouth, larynx, nasopharynx, thyroid, lung, esophagus, stomach (Virchow's node)
- B. Miscellaneous tumors
 - 1. Lipoma
 - 2. Osteoma
 - 3. Fibroma (to include esophageal fibromas)
 - 4. Primary carcinoma
 - 5. Neurofibromas
- C. Carotid body tumors
- D. Salivary gland tumors
 - 1. Parotid—mixed, adenolymphoma, carcinoma
 - 2. Submaxillary gland—mixed, carcinoma, inflammatory with stone
- E. Congenital cysts or tumors
 - 1. Branchial cyst
 - 2. Branchial fistula
 - 3. Carcinoma arising in branchial cyst
 - 4. Dermoid cyst
 - 5. Hygroma
- F. Thyroid and Parathyroid
 - 1. Lingual goiter
 - 2. Pyramidal lobe hyperplasia
 - 3. Adenoma of isthmus
 - 4. Multiple colloid adenomatous goiter
 - 5. Intrathoracic goiter (low neck tumors extending into mediastinum)
 - 6. Carcinoma of thyroid
 - 7. Aberrant thyroid
 - 8. Thyroglossal cyst
 - 9. Parathyroid cysts and tumors

In an effort to illustrate the relative frequency of occurrence of the more common types of neck tumors, we have compiled a list of such tumors in which the patients were treated surgically in the Lahey Clinic up to Jan. 1, 1948. We have excluded from this table the more common lymph node enlargements such as tuberculosis, Hodgkin's disease and metastatic lymph node invasion, and lipomas which are relatively more frequent. We have also not included thyroid adenomas or thyroid carcinoma (Table 1).

Enlargement of the lymph nodes may result from various etiologic factors. It may be due to bacterial invasion as in tuberculosis,

TABLE 1
Tumors of the Neck—Lahey Clinic

Aberrant thyroid	54
Thyroglossal cysts	330
Branchial cysts	103
Branchial sinus	24*
Parotid salivary gland tumors	197
Submaxillary salivary gland excision (for tumor or chronic inflammatory enlargement)	33
Submaxillary salivary gland stone	50*
Dermoid cysts	31
Hygroma	12
Carotid body tumor	22
Total	856

or to metastatic invasion from malignant tumors primary elsewhere or may be evidence of a general blood disease as leukemia or even a primary tumor arising in the node as lymphosarcoma or Hodgkin's disease. It is extremely important in any patient with enlargement of lymph nodes to have a thorough nose and throat examination to rule out primary malignant disease of the nasopharynx, pyriform sinus and larynx, because the primary lesion in these areas may be small and overlooked while the involved nodes in the neck show so much enlargement that they are likely to be considered the primary seat of disease. Overlooking such a primary lesion could be serious and make any radical dissection of the neck futile. The diagnosis of metastatic malignancy must, of course, be established by biopsy of cervical nodes, as must also the identification of the malignant lymphomas. Tuberculous lymphadenitis is a much less common disease than formerly owing to more careful supervision of the milk supply and to a decrease of human tubercle infection. It is more commonly a disease of childhood and ordinarily the submaxillary glands are the first involved. As the disease progresses, periadenitis causes the discrete nodes to be matted together with caseation and softening often later occurring. The submental lymph nodes are rarely affected by tuberculosis but are often invaded by malignancy arising in the mouth or from the lips.

The early diagnosis of Hodgkin's disease is most important from the standpoint of effective treatment. Dr. Hugh F. Hare, in charge of the Department of Radiology, has reviewed the results of treatment of Hodgkin's disease in this clinic. Of 181 patients who had intensive treatment with deep roentgen therapy, only 29 per cent

*Not truly tumors but added for discussion in paper of these two problems in relation to tumors originating similarly.

are alive without recurrence after 5 years. Men are more commonly affected than are women. The deep cervical nodes are enlarged more than is noted in tuberculosis; they are firm, elastic, discrete in early stages, however, later fusing together, but with no caseation or softening. The disease is progressive and one group of nodes after another becomes involved.

One of the most common tumors in the miscellaneous group is the lipoma, which occurs in any part of the neck. The consistency of the tumor, its lobulation and distinct edge, establish the diagnosis readily in the majority of cases but often it is impossible to identify these tumors definitely without surgical removal.

Primary carcinomas of the neck are rare and probably arise from branchial rests or are of parathyroid origin. Bailey stated that the occurrence of branchiogenic carcinoma is not proved and the diagnosis of such should be made only after careful search fails to reveal the primary source in the mouth, nasopharynx, extralaryngeal recesses and the external auditory canal.

Carotid body tumors occur infrequently but present one of the most interesting tumors in the neck, especially in regard to the possibility of development of malignancy and from the standpoint of technical factors seriously complicating their surgical removal. In a recent review of this problem, Lahey and K. W. Warren stated that but 300 carotid body tumors have been reported in the literature, and added 18 cases from this clinic. Since this report we have had 4 more cases in the clinic, making in all 22 cases proved by surgery. Carotid body tumors arise from the carotid body situated at the bifurcation of the common carotid. Their growth is slow and there is an intimate relation between the tumor and the carotid vessels; attempt at surgical removal often necessitates ligation of the carotid vessels which may well result in operative mortality owing to necrosis of brain tissue. In the series of 18 cases there were 3 deaths, 2 resulting from ligation of carotid vessels and 1 from postoperative thrombosis of the common carotid. These 2 deaths from ligation occurred among 6 of the patients subjected to ligation, a mortality of 33 per cent, so that ligation is an extremely hazardous procedure.

Boyd said that these tumors may be regarded as essentially benign, although local involvement of lymph nodes has been recorded. It is estimated by most writers on this subject that 15 to 20 per cent of carotid-body tumors are malignant; however, Harrington, Claggett and Dockerty alone reported a high incidence (50 per cent) of malignant disease in their series of cases. There were no proved cases of malignant degeneration in our 22 tumors. The diagnosis

in the majority of cases can be made fairly readily if the location and occurrence of the tumor are recognized. These tumors arise high in the neck and are deeply located in the neck since they arise at the carotid bifurcation. Any enlargement is upward, under the angle of the mandible, and occasionally they may protrude into the pharynx, as in 2 cases, and may interfere with swallowing, as occurred in one patient in the group of 22 cases. They are firm tumors, discrete unless accompanied by local nodal involvement, can be moved laterally but not up or down due to fixation to the carotid vessels. Occasionally displacement of the carotid artery may be noted when the tumor is moved laterally. If possible, the tumor should be removed at an early stage of its growth, because of the possibility of malignant degeneration and because later growth and fixation may preclude removal without great operative risk. Lahey and Warren discussed the method of approaching this technical problem from the standpoint of safe ligation of carotid vessels when it is found to be necessary. Because of the location of this tumor, effort should be made to avoid injury to the spinal accessory, vagus and hypoglossal nerves. We recently removed a carotid tumor from a patient who had previously had an exploratory operation and removal abandoned because of hemorrhage; in this case all three of these nerves had been injured, with subsequent loss of function. When these tumors are small and do not surround the carotid vessels, and can be excised without ligation of these vessels, removal is justifiable. If the carotid body tumor is so intimately associated with the carotid vessels and ligation is necessary, removal with ligation is advisable only if biopsy shows malignant degeneration to be present.

Salivary gland tumors are not rare and more commonly arise in the parotid and submaxillary glands but may also develop in the submental gland, mucous membrane of the mouth or soft palate. We are concerned in a discussion of tumors of the neck with those arising chiefly in the parotid and submaxillary glands. Their incidence is given as 1 to 2 per cent of all tumors. In this clinic we have operated upon 197 patients with tumors of the parotid gland and 70 patients with tumors of the submaxillary gland. Many of the latter, however, are inflammatory tumefactions due to stone in the gland or duct; there were 9 mixed tumors and one carcinoma simplex of submaxillary gland origin. Nevertheless, this firm enlargement in the neck under the mandible must be distinguished from true neoplasm and it may often be difficult to establish diagnosis without surgical extirpation. These enlargements of the submaxillary gland bulge into the floor of the mouth and can be distinguished by palpation with the examining finger in the mouth.

The most frequent tumor of salivary origin is the mixed tumor of the parotid or submaxillary gland. These tumors are benign but may recur after incomplete excision and may invade locally, especially lymph nodes. One of us (S.F.M.) together with G. O. Miles, recently reported a series of 150 cases of salivary gland tumor, a classification of which is given below, which indicates the type of tumor found in these glands.

CLASSIFICATION OF TUMORS IN THIS GROUP

1. Parotid		
A. Benign		94
a. Mixed tumors	89	
b. Adenolymphoma	5	
B. Malignant		23
a. Adenocarcinoma	8	
b. Malignant mixed tumor	9	
c. Epidermoid carcinoma	2	
d. Lymphosarcoma	2	
e. Hodgkin's disease	1	
f. Neurosarcoma	1	
2. Submaxillary		
A. Benign		11
a. Mixed tumors	11	
B. Malignant		1
a. Hodgkin's disease	1	
3. Miscellaneous Tumors		18
A. Parotid cyst	2	
B. Branchial cyst in parotid gland	1	
C. Angiomas	3	
D. Sarcoid	1	
E. Pre-auricular sebaceous cyst	1	
F. Maxillary inflammation	4	
G. Submaxillary inflammation with calculi	6	
4. No Pathologic Diagnosis		3
		<hr/>
Total		150

A large majority of the parotid mixed tumors were recurrent tumors owing to previous incomplete removal. These tumors should be removed with wide margins of normal gland about the tumor to prevent recurrence. Such thorough removal, of course, increases the incidence of injury of the facial nerve; in our experience this was 30.4 per cent, a much too high incidence of nerve injury. The possibility of malignant disease should always be considered in salivary gland tumors and in this series 20 per cent of the parotid tumors proved to be malignant. The problem, then, is complete removal of the tumor and avoidance of unnecessary injury

to the facial nerve. Either the Adson and Ott method or the Bailey method of identification of the facial nerve can be employed. Incomplete removal will result in recurrence in either the benign mixed tumor or the malignant tumor and will make subsequent attempts at extirpation much more difficult from the standpoint of preservation of the facial nerve. We believe that incomplete removal may in some cases result in malignancy developing in the recurrent nodules. Radiation therapy has proved of no value in the treatment of these tumors and has seriously complicated their later surgical removal.

The possibility of malignant degeneration should always be kept in mind and at the time of operation should be determined by frozen section so that a more radical surgical procedure can be carried out. Thorough excision at the primary operation offers the best opportunity of preservation of the nerve and when the nerve is identified at the beginning of the operation we believe nerve injury can be prevented in the majority of cases.

Tumors or inflammatory enlargements of the submaxillary gland are more easily removed surgically than are tumors of the parotid gland, although injury to the inframandibular branch of the facial nerve is not uncommon unless it is identified and preserved. We have had no case of paralysis resulting from injury to the mandibular branch in this group. In removal of the submaxillary gland it is important, as Bailey pointed out, to realize that the submaxillary gland dips beneath the free posterior border of the mylohyoid muscle and thus forms a cervical portion and a buccal portion. In total removal of the gland it is necessary to remove both portions of the submaxillary gland.

The congenital cysts or tumors of the neck comprise chiefly the cysts of branchial origin, the dermoids and the cystic hygromas. In this group we had 31 true dermoid cysts, 12 cystic hygromas, 103 branchial cysts and 24 branchial fistulas. According to most observers the greater majority of branchial cysts and fistulas arise from the second branchial cleft. The branchial cyst is more common than branchial fistula, as noted in our series. Branchial fistulas may be unilateral or bilateral and are usually congenital, although occasionally they may be acquired, resulting from incision and drainage of a branchial cyst, either through error or for drainage of an abscess. The branchial fistulas are easily diagnosed by reason of the opening of the fistula which is always in the lower third of the neck along the anterior border of the sternomastoid muscle. These fistulas can be removed readily through several small transverse incisions in the neck (stepladder incisions), the tract being dissected beneath the intervening skin. After incision about the orifice of the

fistula, traction can be made on the fistulous tract and dissection can be carried up under the digastric muscle to the lateral pharyngeal wall. Branchial cysts may be confused with other tumors of the neck, especially carotid body tumors, since some cysts have the characteristics of a solid tumor because of tense filling with fluid contents. These tumors are more superficial than carotid body tumors. They occur most commonly at the level of the hyoid bone but lie in contact with the deep surface of the sternomastoid muscle, usually extending anteriorly around the anterior border of the muscle, and produce a thinning of the muscle over the cyst. These cysts rarely lie deeply beneath the angle of the jaw as do carotid body tumors. Exploration of the tumor contents with a small needle will determine the true character of the tumor; the fluid contents contain cholesterol crystals and squamous epithelium. The large majority of these cysts are lined with squamous epithelium on bases of lymph-



Fig. 1. Branchial cyst wall, showing squamous cell epithelial lining of cyst. Note the characteristic lymphoid tissue beneath the squamous epithelium.



Fig. 2. Cyst wall of thyroglossal, showing absence of lymphoid tissue in contrast to branchial cyst wall (fig. 1); usually thyroid epithelium in wall aids in identification.

oid tissue (figs. 1 and 2). The fluid contents are mucoid and contain large numbers of cholesterol crystals. Aspiration and examination of the fluid will often establish the diagnosis from the presence of the cholesterol crystals. If the cyst arises from the internal branchial cleft, however, the epithelium will be columnar and the fluid mucoid; this occurs extremely rarely. Because of the superficial nature of these cysts they can be removed readily through the incision along the anterior border of the sternomastoid muscle, without injury to other neck structures.

Carcinoma of the neck may arise from branchiogenic cysts or epithelial rests, as suggested by Ewing, but must be rare. We have had only one case of carcinoma in this group of 103 cysts. On the other hand, Sir John Bland-Sutton stated that cancer never arises in remnants of the branchial cleft. Bailey believed that such a diagnosis should be made only after a futile search for a primary growth elsewhere.

Dermoids arise as true sequestration cysts, which lie beneath the skin and superficial fascia and are formed by the inclusion of epidermal elements during the closure of the midline of the neck. The contents consist of sebaceous material. They may also be lateral, arising from the first cleft.

Hygromas in our experience have been rare, there being only 12 cases. This is probably due to the fact that the large majority of our patients are adults and these tumors commonly are seen in children. The usual site is the lower third of the neck in the anterior triangle or beneath the sternomastoid muscle. If the swelling is aspirated, a thin serous fluid is obtained, which establishes the diagnosis. The tumor consists of lymph vessels which undergo cystic dilatation, which may undergo spontaneous retrogression. Complete removal can be accomplished but recurrence is not uncommon.

As indicated previously, many of the tumors and cysts of the neck are of developmental origin. This is particularly true in regard to the thyroid gland, which is the site of perhaps the largest number of tumors or cysts recurring in the midline of the neck. Many of these tumors arise from the thyroid gland itself or from the vestigial remains of the thyroglossal duct which passes from the foramen cecum at the base of the tongue to the isthmus of the thyroid. Most of these tumor masses appear below the level of the hyoid bone but they may also occur above the hyoid bone or may involve the back of the tongue. Should they appear over the hyoid bone, as do the thyroglossal cysts, they may be very firmly attached to the hyoid and present problems in the surgical technic in regard to their removal.

The diagnosis of the multiple colloid adenomatous goiter is a fairly simple one as the origin of these multiple nodules is in the thyroid lobes; this can be determined by the fact that these tumors ascend and descend with swallowing and arise either on the thyroid cartilage or trachea or immediately within the thyroid lobes lateral to the trachea. Intrathoracic goiters should probably be considered in the group of neck tumors because they are associated with multiple adenomatous goiters and will project through the superior thoracic strait into the upper mediastinal cavity. The extension from the nodular goiter into the chest can be determined by palpation in most cases, but occasionally large intrathoracic goiters are seen which apparently have no connection with the thyroid lobe on either side (fig. 3). However, roentgenologic examination of the

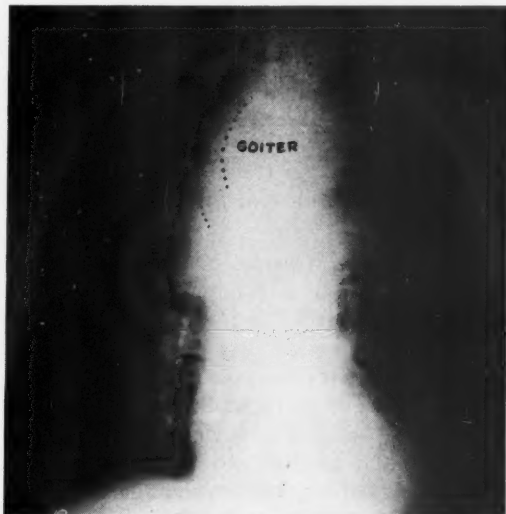


Fig. 3. Very large intrathoracic goiter. Note deviation of trachea. This tumor extended below the arch of the aorta and was removed without resection of the sternum.

mediastinum and the lower neck shows deviation of the trachea and many times rather marked lateral compression of the trachea; the shadow of the intrathoracic portion of the goiter will be rather sharply delineated.

Of more significance are the discrete adenomas of the thyroid which should never be particularly difficult to diagnose because they too arise from the thyroid lobe, can be palpated readily and will rise in the neck with deglutition. Discrete adenomas of the thyroid are important because of their relationship to thyroid malignancy.

It has long been the opinion at this clinic that all adenomas of the thyroid should be removed since they present simple surgical problems and should carry no operative mortality with them. The incidence of malignant disease arising from the thyroid gland has varied in this clinic from year to year. In 1928 the incidence was 10 per cent, while in 1933 it had dropped to 3.2 per cent. Over a 10 year period, 1926-1936, 1,971 simple adenomas of the thyroid were removed and in the same period 236 malignancies of the thyroid gland were demonstrated, an incidence of 12 per cent, which is extremely high. Dr. Hugh F. Hare of this clinic, in numerous publications on the subject of cancer of the thyroid, has given the histologic classification as suggested by Shields Warren which has proved to be very helpful to us from the standpoint of treatment and prognosis.

The 5 year survival rate in a group of 231 cases varied from 80 per cent in the papillary adenocarcinomas to a figure as low as 17 per cent in those with the giant-cell carcinomas. It is important to do radical operations when cancer of the thyroid is discovered. Not only should the gland on the side on which the carcinoma developed be removed but also a radical neck dissection must be carried out, this later to be followed by an intensive course of deep x-ray therapy.

Lingual thyroid arising from an undescended thyroglossal tract may occur as supralingual, infralingual and intralingual thyroid tumors. These are in relation to the back of the tongue and are considered as neck tumors since they can be demonstrated by x-ray examination taken in the lateral position. We have had only 3 of these tumors, one supralingual and 2 intralingual thyroids but no infralingual thyroids. Because of their size they may interfere with swallowing and demand surgical attention as a result of this difficulty. It is important before their removal, however, to be certain of the presence of normal thyroid gland since the lingual goiter usually comprises all the thyroid tissue that the patient may possess. The patients should also be advised that with removal they may develop evidence of thyroid deficiency and it may be necessary to take thyroid extract daily the rest of their lives.

Another tumor arising from the thyroid is that of hyperplastic enlargement of the pyramidal lobes. Failure to remove the pyramidal lobe at the time of thyroidectomy for hyperthyroidism will often result in marked hyperplasia of the pyramidal lobe and quite marked enlargement. When enlargement is noted it extends from the level of the thyroid isthmus to the level of the hyoid bone. It may cause an unsightly protrusion in that part of the neck. These thyroid and pyramidal enlargements can be readily recognized be-

cause of their position, because of the history of previous operation and because of their consistency. They also can be easily removed at reoperation, which is a simple technical procedure and, unlike thyroglossal cysts, it is not necessary to remove the central portion of the hyoid bone. They may be confused with discrete adenomas arising in the thyroglossal tract or in the pyramidal lobe or even with thyroglossal cysts. However, their development in the pyramidal lobe in the course of the thyroglossal duct is readily demonstrated and should cause very little confusion.

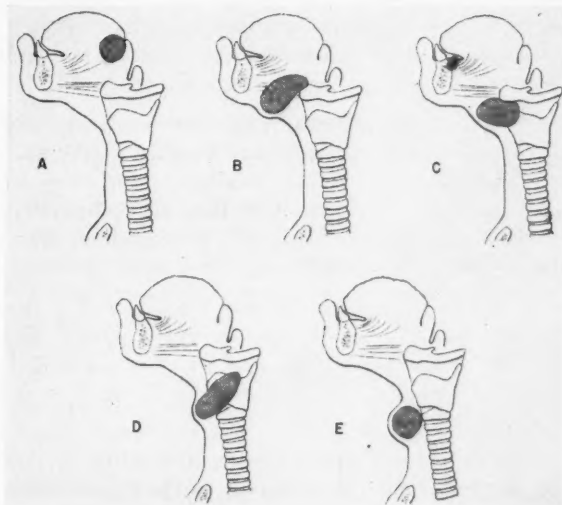


Fig. 4. Levels of development of thyroglossal cysts: *a*, beneath foramen cecum; *b*, suprahyoid cyst; *c*, infrahyoid cyst; *d*, at thyroid cartilage level; *e*, cricoid.

One of the most common tumors encountered of thyroid origin is the thyroglossal cyst. In our group of neck tumors classified above there were 330 thyroglossal cysts or sinuses. Of this group 89 patients had had previous operation, that is, previous attempts had been made to remove them or simple incision and drainage had been previously carried out. Thyroglossal fistulas or sinuses rarely are congenital conditions. We have seen no patients with true fistulas present at birth, although thyroglossal cysts are seen very early in childhood. Most of these fistulas result from suppuration in a thyroglossal cyst which ruptures spontaneously or fistulas develop by incision and drainage of the suppurative process in the thyroglossal cyst.

Since thyroglossal cysts develop from the remnants of the thyroglossal tract, they may occur at any level of the neck and may extend

from the suprasternal notch to the foramen cecum on the back of the tongue (fig. 4). In our group of cases the common site for the development of thyroglossal cysts was just beneath the hyoid bone. Many so-called lingual dermoids are in all probability thyroglossal cysts occurring in the mouth. These cysts are usually in the midline, although they may lie at the left side of the thyroid cartilage if they develop at this level since the levator glandulae thyroideae is usually found on the left side of the thyroid cartilage. This deviation toward the left side will often cause some confusion in the differential diagnosis. A thyroglossal cyst is not uncommon in children and even in babies, whereas branchial cysts, which are lateral in origin, usually occur in early adult life, rarely before puberty, and are not seen in very young children.

The diagnosis of thyroglossal cyst is a relatively easy matter because of its position in the neck, and because of the fact that the cyst very often moves upward on swallowing or on protrusion of the tongue, and such upward motion may serve to differentiate it from a midline dermoid cyst which does not show this elevation upon swallowing or upon protruding the tongue.

As stated above, 89 patients in this group of 330 thyroglossal cysts or fistulas had previously been operated upon which had resulted either in recurrence of the cyst or in a draining fistula. A draining cervical fistula in the midline may be easily recognized as arising in a thyroglossal cyst.

The operation is not a difficult procedure when it is recognized that the thyroglossal tract is adherent to the hyoid bone and may extend up to the base of the tongue, and that every vestige of the thyroglossal tract should be removed in order to prevent recurrence. Sistrunk early realized that many recurrent cysts and sinuses were seen after incomplete operation. He developed a surgical technic for radical removal which has given excellent results and has not proved to be technically difficult. The dissection of the infrahyoid portion of the thyroglossal cyst and tract is relatively easy. The dissection is carried up to the hyoid bone. The central section of the hyoid bone is removed intact with the cyst, and the continuation of the tract is followed and excised up to the base of the tongue (fig. 5). We have had no recurrences with this radical removal nor has the removal of the central portion of the hyoid bone given any post-operative difficulty.

There have been many theories about the development of the thyroglossal tract in relation to the hyoid bone. Possibly the generally accepted one is that of Sir Arthur Keith who stated that the hyoid bone develops in the course of and interrupts the continuity

of the thyroglossal tract. Consequently, the central portion of the hyoid bone should be removed to prevent recurrences. All of our patients who had been operated on before admission to the clinic had not had removal of the central portion of the hyoid bone.

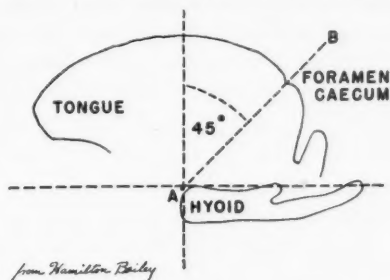


Fig. 5. Course of suprahyoid tract of thyroglossal.

The incision for removal of these cysts should always be transverse and usually made at the level of the hyoid bone. It is well to pay attention to complete hemostasis; a small Penrose tube should be introduced at the upper level of the dissection and brought out through the skin incision. Late hemorrhage with pressure upon the thin thyrohyoid membrane may cause some pressure symptoms and difficulty with respiration if attention is not paid to this detail. Needless to say, the incision should never be made vertical because of the unsightly scar that will stand out prominently with elevation of the chin.

One of the most interesting tumors developing in the neck is the single discrete or multiple nodules arising from aberrant thyroid tissue. It is well to recognize that there is some dispute regarding the term aberrant thyroid tissue inasmuch as this arises from the ultimobranchial body which comes off the fifth branchial pouch and does not have the same developmental origin that the true thyroid tissue has. During the growth of the thyroid the ultimobranchial bodies come in contact and fuse or are incorporated into the thyroid lobe. This implanted tissue may develop as a tumor in the thyroid lobe itself, or may occur as a chain of multiple gland-like masses, occurring along the internal jugular vein and along the anterior margin of the sternohyoid muscle. This aberrant thyroid tissue may be lateral or median, may be benign or may develop malignancy which may be difficult to recognize histologically from malignancy developing in the thyroid gland since the tumor is a papillary cystadenoma and should be regarded as potentially malignant. Some of the cases were definitely adenocarcinoma with blood vessel invasion.

The clinical differentiation of neck tumors is not difficult if one

remembers that any laterally located mass along the course of the sternomastoid muscle may represent lateral aberrant thyroid tumor. Lahey and Ficarra, in 1946, reported on 47 cases of tumors of lateral aberrant thyroid origin. Since that report 7 additional patients have been operated on in this clinic, making in all a total of 54 cases. The gross appearance of these lateral aberrant thyroids is in many instances quite characteristic. The diagnosis is suggested by the bluish-black discoloration of the tumor tissue.

At operation, radical neck dissection is carried out on the involved side. When several nodules are encountered, especially in the presence of a tumor with invasive tendency and with a frozen section, the diagnosis is papillary adenocarcinoma. When a discrete nodule is found in the thyroid lobe without evidence of multiple lateral nodules, complete removal of this nodule will usually be sufficient. If the thyroid gland on that side is involved, complete removal of that lobe is indicated. Operation in these cases should be followed by deep x-ray therapy.

The tumors originating in the parathyroids are chiefly of three types: the adenomas, cysts and malignant tumors. First are the parathyroid adenomas which may be directly related to the thyroid gland and located posteriorly or they may even develop within the thyroid gland itself. Hyperplasia of the parathyroid may be associated with osteomalacia, osteoporosis or rickets and has been regarded as adenomatous. The diagnosis is suggested by the finding of disturbance of calcium metabolism. Parathyroid cysts likewise occur in contact with the thyroid and are usually found posterior to the thyroid in man. An occasional malignant tumor of the parathyroid gland occurs; they are firm, nodular, adherent, rapidly-growing and are accompanied by pain, interference with respiration, invasion of lymph nodes and distant metastases. All of these tumors occur relatively infrequently and the diagnosis in most cases has to be established by pathologic section.

As stated above, many of the tumors and fistulas of the neck are of developmental origin. Diagnosis in many cases can be established early, but also the true nature of the tumor cannot always be determined in a large percentage of these except by pathologic examination after extirpation. It is extremely important to be certain of the nature of the tumors of the neck because of their tendency to become malignant or because of the possibility that they are primary malignant tumors of the neck.

Any approach to the surgical treatment of tumors of the neck should be made with a clear understanding of the nature of the tumors and of the technical surgical procedures involved in their

extirpation. Half-hearted attempts at biopsy or partial removal of tumors may be disastrous and may result in irremovable recurrent tumors or make the technical procedure for the complete operative removal a difficult and tedious surgical dissection. This is particularly true in incomplete removals of the parotid gland, and most of the facial nerve injuries are associated with reoperative cases in which the adherent scar has destroyed anatomic outlines and prevents identification and preservation of the facial nerve. These technical difficulties also pertain to the neck; identification and preservation of the important structures of the neck may be impossible in adherent cases in which operation has been performed. This is particularly seen in reoperated cases in attempting to preserve the vagus nerve, the hypoglossal nerve and the spinal accessory nerve and to prevent injuries to the great vessels of the neck. With removal of the thyroid lobe in certain thyroid tumors, of course, attention must be paid to preservation of the recurrent laryngeal nerve.

If radical dissection of the neck is considered necessary, the removal should include the sternomastoid muscle, the jugular vein and all of the gland structures that may possibly be invaded by a malignant tumor on the affected side to be followed later by deep roentgen therapy as indicated by the type of tumor found at operation.

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MELANOMA

V. HUGH PRICE, M.D.

CHARLES D. KNIGHT, M.D.

W. R. MATHEWS, M.D.

Shreveport, La.

THIS report is based on a clinical study of 100 cases of melanoma in the Tumor Clinic of the Shreveport Charity Hospital of Shreveport, Louisiana, during a period of 15 years (July, 1932 to July, 1947). In this clinic the term melanoma is used to designate all malignant tumors derived from melanin-producing cells (melanoblasts). This study includes only those cases which have been proved histologically.

ANATOMIC DISTRIBUTION

Melanomas may occur on any part of the body; in our series the following distribution of primary sites was found:

I. Skin

A. Head and neck	37
Scalp	1
Ear	5
Face	21
Neck	10
B. Trunk	23
Back	16
Chest	5
Breast	2
C. Genitalia	1
Penis	1
D. Upper Extremity	7
Arm	4
Hand	3
E. Lower Extremity	23
Thigh	2
Leg	6
Foot	15

II. Miscellaneous

Eye	3
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From Departments of Surgery and Pathology, Shreveport Charity Hospital, Shreveport, Louisiana.

Soft Palate	1
Schneiderian Membrane	1
Unknown	4

As seen from the above data the distribution in this series is comparable to that of Pack's 851 cases⁶ in which he reports 21.1 per cent on the head and neck, 14.4 per cent on the feet, 17.9 per cent on the trunk, 12.7 per cent on the leg, 10.1 per cent on the arm, and .4 per cent on the male genitalia, 2.6 per cent in the oronasal cavity and 1.5 per cent of undetermined origin. Of particular interest in our series is the one case of melanoma found occurring in the Schneiderian membrane of a 75 year old white male. This lesion is quite rare, for as pointed out in a recent review of the literature,⁵ only 62 cases have been reported.

AGE-SEX-COLOR

As to age, the greatest number of cases were found in the three decades from 40 to 69 inclusive, the youngest being 13 years old, the oldest being 84 years old. Of interest is the case of a 10 year old male (not included in this study) whose lesion when removed from the dorsum of the foot clinically and histologically appeared malignant. However, a 12 year follow-up has passed with no evidence of metastasis found.

As to sex, 54 per cent of the patients were male and 46 per cent were female. This incidence disagrees slightly with that in some series,^{4,9} but is similar to that of others^{3,7} which noted males to predominate. In general it may be said that the incidence is equally divided between the sexes.

It is a well known fact that the incidence of melanoma in the negro is much less than in the white; a ratio of 1 to 4 is reported by Anderson.² In our series 16 negro patients were studied (8 males and 8 females). This study tends to disprove the belief that melanoma in the negro is more prone to occur in the depigmented areas of the skin, for the primary sites were as follows:

Temporal Region	1
Lower Leg	3
Eye	2
Foot	
Sole	5
Dorsum	2
Hand	1
Unknown	2

In a recent comprehensive review of the literature of melanoma

of the negro, Imler and Underwood⁶ reported 6 cases which brought the total number of recorded cases to 79.

GENERAL CONSIDERATIONS

A large number of melanomas arise from pigmented nevi of the skin, 43 per cent being observed in this series; others seem to have no predisposing lesions. Certain pertinent facts have been reported by Adair¹ which are worth reemphasizing, namely, that there is a disparity between malignant and benign moles on different parts of the body. Whereas, the two forms are of equal incidence on the face, back, upper arm, and neck, malignant melanomas frequently involve the feet and genitalia where nevi are uncommon. Nevi are more frequently found on the upper extremity while melanomas are more frequent on the lower extremity.

There are certain factors which seem to play a rôle as a causative agent in the transformation of a benign pigmented nevus to a melanoma. Trauma has frequently been cited in the form of irritation of clothing, scratching, cutting, bruising, the application of various medications, and incomplete removal of a nevus. In this series 60 per cent of the cases arising from a previously existing mole gave a history of trauma. Another factor which seems to play a rôle is that of hormones. Lesions encountered before puberty that appeared malignant clinically and histologically, when adequately excised, have never been followed by local recurrence or metastasis in our experience. The benignity of melanoma at this period of life has been emphasized by others. Further evidence of this hormonal rôle is exemplified by the rapid growth of these lesions during pregnancy. One such case was seen in this group, a 28 year old female with early rapid growth and widespread metastasis from a clinically benign but histologically malignant mole.

Metastasis occurs quite early and on numerous occasions occurs before appreciable change is noted in the primary site. The usual route of metastasis is to the regional lymph nodes by way of the lymphatics, but widespread metastasis via the vascular route is not uncommon. It may be said that melanomas may metastasize to any tissue in the body. The average length of time noted from activity at the primary site to that of metastasis was 14 months in this study. The shortest time was 3 months and the longest 6 years. The proved sites of distant metastasis in this group were as follows:

Regional Lymph Nodes.....	40
Lungs	13
Bones	7
Skin	7

Brain	5
Liver	5
Intestines	2
Adrenals	2
Pericardium	1
Epicardium	1
Kidneys	1
Retroperitoneal Nodes	1
Peritoneum	1

TREATMENT

A. Prophylactic Treatment

As mentioned above a good percentage (43 per cent in this study) of melanomas arises from pigmented nevi. Pack⁶ has pointed out that the frequency of these precursory lesions has been underestimated. The average adult has at least 20 pigmented nevi scattered over the body surface. In color these nevi vary a great deal, ranging from slate blue to jet black, together with varying shades of brown. Since pigmented nevi are quite common and melanomas are relatively rare, the course as to the proper handling of these lesions presents quite a problem. It is generally agreed that it is impractical to remove all nevi; however, there is definite clinical evidence that those moles that have any black pigment, and those subjected to repeated trauma should be removed prophylactically. It is our policy not to do a biopsy but to excise adequately all such nevi with the scalpel, taking care to perform this procedure with the minimum of trauma. Where there is any suspicion of the possibility of early malignant transformation, we feel that the procedure should be carried out under general anesthesia with a wide excision including subcutaneous tissue and fascia. No instrument should be applied directly to the neval mass. Thus, the hazard of disseminating the malignant cells if present is greatly lessened. All specimens are sent to the pathologic laboratory for histologic study.

Another aspect in this phase of treatment which in the past has been neglected is the removal of pigmented moles in children before puberty, especially those subjected to repeated trauma. For, as stated above, rarely does one of these lesions metastasize if adequately removed. Therefore, an earnest plea is put forth that physicians examining children point out this fact to their parents and recommend that such lesions be removed before puberty. If this is carried out, one might expect the frequency of melanoma to be lower in the future.

B. Active Treatment

It is well known that unless melanomas are adequately excised prior to metastasis the prognosis is very grave. It has been quite interesting in this study which covers a period of 15 years to see the various methods of treatment—simple excision, excision and x-ray, x-ray alone, electrodesiccation of pigmented moles, and lastly, wide surgical excision with block dissection of the intervening lymph nodes.

The experience of this clinic agrees with the consensus that melanomas are radioresistant tumors and x-ray treatment has no rôle as a curative procedure. In recent years surgical excision has been considered the appropriate method of treatment. The radical surgical treatment as championed by Pack is followed—so-called excision and dissection in continuity for primary and metastatic melanoma in regional nodes.⁸ However, considerable difficulty has been encountered in convincing our patients that such a radical procedure is necessary. If the patient does not submit to a radical procedure, wide excision of the whole area and skin graft is carried out. Regional lymph node dissection is done if the patient will submit. These patients are followed closely in the outpatient clinic, and all recurrent lesions are excised immediately.

C. Results

Of 100 patients treated from July, 1932, to July, 1947, with proved cases of melanoma, 14 survived 5 years or longer. Of these one is living 15 years following therapy, and 3 others are living more than 10 years. There are 10 patients now being followed in the clinic who were alive and well at their last visit, but their original treatment was less than 5 years ago. In other words, this group has not had a chance to reach the 5 year survival group. There are 17 other patients who were alive when last heard from, but have not been seen in the clinic within the past year, so these have not been considered as living in our statistical study.

These results are based upon all patients admitted to the Tumor Clinic of the Shreveport Charity Hospital with malignant melanomas in all stages of the disease, including all of the inoperable and recurrent cases.

Although the over-all survival rate is 14 per cent, this does not mean that this percentage has been cured of melanoma. Some of these patients have subsequently died of their diseases.

It is difficult to reach any conclusions from this study regarding the best method of therapy. During a 15 year period almost every conceivable form of therapy has been tried. The variety alone in-

icates that no specific method has given satisfactory results and leads one to suspect that the unpredictable vagaries of the disease itself have been a considerable factor in the results in this series of cases. Since the advent of radical surgery in this clinic 3 years ago, the number of cases is too small to be evaluated statistically. However, the patients treated in this manner are all doing well and there has been no operative mortality.

SUMMARY

A clinical study of 100 cases of melanoma has been presented.

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PLASTIC PROCEDURES FOR THE GENERAL SURGEON

CHARLES C. TRABUE, M.D.

Nashville, Tenn.

AS AN introduction it should be made clear that I am not a plastic surgeon. I am a general surgeon and this paper is presented for the interest of other general surgeons—all of whom have the need at some time for a knowledge of certain plastic procedures. The more simple types of skin grafts are often indicated in many conditions treated by the general surgeon. Probably the most frequent such condition to be seen is burns. Grafts are also indicated in the treatment of varicose and other ulcers of the legs; following the removal of malignant or large benign lesions of the skin and underlying tissues; in the early or the late treatment of trauma; following radical mastectomy and in many other conditions.

Pedicle grafts and tube grafts should remain in the field of plastic surgery to be used by those men with specialized training and skill. The successful use of pinch grafts, various types of split grafts and the full thickness free grafts do not require any high degree of specialized training and they may be used to great advantage by the general surgeon. The Reverdin, or pinch graft was very widely used 10 or 15 years ago. Since that time it has rapidly lost favor because the donor area becomes an unsightly scar and the recipient area even more unsightly. Thus it should never be used on any part of the body where the cosmetic appearance is to be considered. Moreover, the resultant skin contains so much fibrous tissue that it is not soft and pliable. The advantage of the pinch graft is its simplicity. With the use of a little novocaine, a surgical knife and a straight needle grasped by a hemostat the procedure can very easily be carried out in the office or at the hospital bed of a non-transportable patient. In general, however, pinch grafts are no more than second best and the indications for their use occur very seldom.

This leaves, then, for the use of the general surgeon the split thickness graft and the full thickness free graft. The split graft is cut either with a long-bladed knife (which is a modification of a straight-edged razor) or with a Padgett dermatome. The technic of the use of each instrument is simple and, since it has been described many times, will not be repeated here. The true Thiersch graft is the thinnest of all grafts, being one-fifth to one-fourth of full skin thickness. Between this very thin graft and the full thickness graft one may cut a graft of any thickness desired to suit the special indi-

cations of the individual case. Following removal of a split graft the donor site will heal spontaneously since the deepest layer of the skin is not removed.

Full thickness free grafts are taken without any special instruments by simply cutting away, with great care, all of the underlying fat and subcutaneous tissue from the skin as it is being removed from the donor site. Since the entire thickness of the skin is removed, it is necessary to cover the donor site with a split graft, if it is too large to close by suture.

There are a few principles which the surgeon must bear in mind in choosing between a thin split graft, a thick split graft and a full thickness free graft. The thick grafts are more pliable and have less tendency to contract and are therefore better suited for flexor and extensor surfaces close to joints. The full thickness grafts are more durable and thus should be used in those areas where pressure or trauma will occur. The thick grafts will more nearly match in appearance the surrounding skin and thus they have a cosmetic advantage. However, full thickness free grafts have definite limitations in that they will survive only when placed on a relatively sterile bed. They will not survive when placed on granulations. Thus the thinner split grafts are more likely to survive under poor conditions, but the thick split grafts or the full thickness free grafts will result in a skin which is more pliable, more durable and better looking.

During recent years there has been a considerable amount of experimental work done with a view toward reducing the morbidity in burn cases. This has been chiefly an effort to find a practical method of covering the burned area with grafts at the earliest possible dates. Dr. Oliver Cope and his associates, of Boston, published an article in January, 1947, reporting their experiences in attempting the ultimate in early skin grafting, that is, primary grafting within just a few hours after the patient had received the burn. The method followed was to excise completely the skin and underlying tissue destroyed by a third degree burn and immediately replace it with a split thickness graft. All of the burns receiving primary grafts were relatively small—none comprising more than 3 per cent of the body surface. The results in this group were excellent and the healing time was certainly much less than it would have been if the destroyed skin had been allowed to slough and granulate before the application of a graft. The advantages of this early grafting are that an infected granulating wound is avoided, hospitalization and disability are decreased and the end result is excellent because there is a minimum of scarring, keloid and contracture.

There are several limitations of this type of treatment, especially

in patients with large burns. First, shock may prevent the administration of an anesthetic and the carrying out of the tedious operative procedure during the first few hours. Second, the amount of skin as a donor site may be inadequate for large split grafts. After a period of time the healing of first and second degree burns will provide more donor skin. Third, there is great technical difficulty in outlining the skin which has received a third degree burn and thus the line for excision is hard to determine. If any of the third degree burn is left, it will, of course, become infected and jeopardize the graft. In those cases in which excision of the burn and grafting was carried out after several days the results were not so satisfactory. Therefore, it seems that early excision and grafting of third degree burns may well be the treatment of choice for relatively small burns and where shock is absent or where shock can be controlled within a few hours.

Drs. Harvey and Connor have sought to hasten the slough of the burned tissue by the application of various chemicals. The compound which they found most effective was pyruvic acid in a starch paste. They contend that the use of this paste will allow the slough to be separated from the unburned tissue in from 3 to 5 days and that the wound is then ready for grafting. I have used this treatment a few times and am not too enthusiastic about the results. I have not found it possible to separate the burned tissue and apply a graft in 5 days in any case with a large burned area in spite of following meticulously the treatment outlined. Sulzburger and co-workers have done further work in an effort to find a compound more stable than the pyruvic acid in starch and hence one which could be kept more readily available. They have recommended the use of pyruvic or phosphoric acid in methyl cellulose or K-Y jelly.

In general practice burns are treated by a multiplicity of different methods and are usually not ready for grafting in less than 2 to 3 weeks or longer. It is certainly desirable to graft these third degree burns as early as possible in order to minimize as much as possible the scarring and contractures which increase week by week until they are healed. Other reasons for early grafting of burns are to improve the morale of the patient, to avoid prolonged hospitalization and disability and to avoid the continued loss of proteins from the granulations. However, the graft cannot safely be applied until all sloughs have separated and the granulations have become firm and healthy. The granulations will not be healthy unless the hemoglobin level and the serum protein level are kept close to normal. Low serum proteins and low hemoglobin are frequently the underlying cause of poor results. The granulations should be prepared for grafting by the use of warm boric acid packs of flat gauze en-

circled by an elastic bandage where possible. Penicillin should be given for about 48 hours preoperatively.



Fig. 1. Seven year old boy was first seen 3 years after burning right leg. Dermatome graft was 85 per cent successful. Remaining granulations covered with postage stamp and pinch grafts. The graft lacks durability because of dense underlying fibrosis due to prolonged period of granulation.

Because burn granulations are always infected, a full thickness graft can never be used. A split thickness graft of about $1/3$ to $1/2$ of the full depth of the skin is indicated. In burns the so-called "postage stamp" grafts are also useful. These grafts are made by cutting a split graft in the usual way and then dividing the large sheets into smaller segments, usually about the size of an ordinary postage stamp. This type of graft is particularly useful where the burned area is irregular in shape with islands of epithelium or where, in very large burns, there is insufficient donor skin to allow full coverage of the burn. By the use of plasma and thrombin the necessity for suturing these small grafts can be eliminated. If not more than one centimeter is left between the grafts, these areas will usually rather quickly undergo epithelization from the grafts.

All too often do we see third degree burns which have been allowed to granulate for many weeks or even months with no attempt made to graft them. Such neglect is not a credit to the profession (fig. 1).

The late contractures which result from burns may present a more complicated plastic problem. Pedicle flaps or Z-plasties may

be required, particularly around the neck. But, if the scar is not too deep, it may be excised and a free full thickness graft will make a satisfactory skin. Split grafts should very rarely be used because they do not have sufficient elasticity to be used over a joint.



Fig. 2. This small child was injured in a street accident with avulsion of a segment of skin from the forearm. Closure, even with undermining, would have been impossible. Therefore, a split graft was immediately applied with the satisfactory result which is shown 3 weeks after the accident. There remains an unhealed abrasion of skin close to graft.

Grafts are often indicated in the treatment of wounds incurred in automobile accidents and other mishaps. These accidents may result in total avulsion or destruction of more or less skin. It is usually possible to cover this defect by widely undermining the surrounding skin and pulling it together with sutures. But there are times when this is not possible, particularly in injuries to the fingers, foot, lower portions of arm, the ankle region and the face. If suturing produces considerable tension the result will be less satisfactory than if a graft is used. It is not realized by all surgeons that a fresh wound offers the very best possible site for the growth of a graft. If the general condition of the patient will allow a short anesthetic, then the application of a split graft is indicated at the earliest possible time—and this does not mean the following morning. The operation should be considered just as much an emergency as the first aid treatment of a wound or the reduction of a fracture. Thorough debridement and thorough cleansing of the wound by irrigation and the accomplishment of complete hemostasis is the only preparation needed before the application of the graft (fig. 2).

Grafts do not ordinarily take when placed directly over exposed bone. Therefore, if there is a wound with skin loss of the anterior surface of the leg, the skin may be undermined for a considerable distance by a counter incision made paralleling the wound on one or both sides of the leg. The original wound may then be closed over the bone without tension, giving a full thickness of skin and subcutaneous tissue to cover the bone. The wound produced by the relaxing incision may now be covered with a split graft.



Fig. 3. This 13 year old boy was injured when his bicycle was struck by a car. A large triangular-shaped wedge of skin was peeled back and badly contused. It was cleansed and sutured, but a large portion of it became necrotic and was excised. Two weeks after the accident the wound was covered with a thick split graft. He now has a very pliable and durable skin.

Wounds of the face present a special problem in that the cosmetic result is of great importance. Split thickness grafts or even small full thickness grafts will usually take on the face, if applied early to a thoroughly cleansed wound. If this does not give the desired cosmetic result it will at least prevent infection and deep scarring and the skin will be in ideal condition for the plastic surgeon at a later date.

If a general anesthetic is contraindicated by the condition of the patient immediately after the accident, the wound may be treated by careful debridement and cleansing under a local anesthetic. A large firmly applied dressing is then used and plans are made to apply a split graft at the first dressing a few days later. Either primary grafting or grafting within a few days after the accident is much better than waiting for granulations to develop.

If, in a wound which has been sutured, necrosis develops because the skin was devitalized by the original trauma or because of too much tension by the sutures or because of infection, then the resultant defect should be covered with a split graft at the earliest possible time. However, before applying the graft it is important to be certain that the necrosis has reached its limit, that the slough has separated and that there is no invasive infection present (fig. 3).

Chronic ulcers are seen quite frequently in everyday practice. Those seen most commonly are ulcers of the leg secondary to varicose veins, old thrombophlebitis or trauma. These ulcers are a constant or a recurrent source of annoyance and disability to the patient and may result in a Marjolin's ulcer or squamous cell carcinoma. If such an ulcer fails to respond to the usual methods of treatment, a great deal of time and disability may be saved by complete excision and grafting. It is wise in such cases to be radical rather than conservative in the excision of the surrounding skin. The ulcer itself is usually surrounded by an area of fibrosis of the underlying tissue and dermatitis of the skin proper and in order to get a good result and one which will remain permanently satisfactory, all of this fibrosis and dermatitis must be excised, en bloc, with the ulcer. This excision should extend through the skin and subcutaneous tissue to a sufficient depth so that the ulcer is completely undermined and none of the granulations or fibrous scar tissue remains in the wound. A thick split graft is then applied and held in place with sutures, skin clips or by fibrin fixation. Post-operatively special attention should be given to the application of elastic bandages from the toes to well above the knee because of the deficiency in venous circulation which is frequently existent. Immobilization can best be obtained with a Thomas splint or a light plaster cast. The leg should not be allowed to become dependent until healing of the graft is established (fig. 4).

If there is any arterial disease present, particularly in those traumatic ulcers which are accompanied by arterial spasm, an associated lumbar sympathectomy should be done.

It has been recommended for many years that skin grafts be used for the closure of the operative defect of all radical mastectomies.



Fig. 4. This photograph was made one year after excision and grafting of a chronic leg ulcer and surrounding area of dermatitis which proved on microscopic section to be a squamous cell carcinoma. There were associated varicosities.

The majority of surgeons feel that the use of such a method is not at all necessary in every case, but that it is very much worthwhile in some cases. It is a comfort in doing radical mastectomies to know that one does not have to limit his incision in order to leave sufficient skin for closure. Enormous defects over the chest wall may be closed by wide undermining of the skin, but even when this can be done the results will be poor, if the tension on the skin has been too great. In such cases even a small slough of the suture line will be slow to heal and will leave a painful, fixed scar. The virtue of the graft method of closure, however, does not lie in the fact that it is an easy method of closure or a particularly quick one or that the resultant scar is universally more satisfactory. The real value of the method is that the surgeon who has confidence in his own ability to cut and apply a graft will feel no restriction or limitations when the removal of a large amount of skin over the cancer is indicated. The extra preparations necessitated by a graft following mastectomy are minimal. One thigh, as well as the breast and axilla should be shaved. A Blair-Brown knife with a Marck's attachment, is the only instrument necessary to add to the operating room set-up.



Fig. 5. This photograph was made one year after radical mastectomy and the application of a split graft. The graft is elastic and pliable and there is a free range of shoulder motion.



Fig. 6. This man had an x-ray dermatitis of several years' duration. The pruritis was so severe that he had been confined to a sanitarium for 2 months prior to operation. There was considerable superficial ulceration where the lesion had been scratched by the patient. A somewhat circular area, 12 cm. in diameter, was excised. The skin incisions were then extended laterally to create flaps, which, after being widely undermined, were brought in from the buttocks and sutured in the midline. The photograph is made 6 months after operation and the patient is entirely free of pruritis.

If then the graft is needed at the end of the operation, it may very quickly be cut and sutured in place with the addition of only a very few minutes to the operative time (fig. 5).

In addition to skin grafts the general surgeon should keep in mind certain other principles frequently used by the plastic surgeon. One of the simplest and most valuable of these is the use of relaxing incisions to shift the skin and subcutaneous tissue in order to close a defect that they would not otherwise cover. When this principle is used in conjunction with very extensive undermining of the skin and subcutaneous tissue a surprisingly large defect may be covered. Such an operation is more tedious and time-consuming than is a split thickness skin graft, but much less so than a pedicle or tube graft. In other words, in those areas of the body which have to bear pressure and which are subjected to considerable trauma, the use of a split thickness graft is contraindicated and the use of a pedicle or tube graft requires long hospitalization and multiple operative procedures. One such area is the sacral region and several interesting papers have been published on the excision of decubitus ulcers and the closure of the defect by the shifting of adjacent skin and subcutaneous tissue (fig. 6).

In conclusion: this paper has been presented to bring to the attention of the general surgeon a few simple plastic procedures which he can use in his everyday practice. Photographs are shown, not because they are in any way exceptional, but to illustrate that satisfactory results can be obtained by a general surgeon with no special training in plastic surgery.

CANCER OF THE CERVIX AS SEEN IN A RURAL COMMUNITY

W. H. CAVE, M.D., F.A.C.S.

Greenville, Miss.

THIS paper represents a study of 71 cases of cancer of the cervix treated in a small community, both in private practice and those referred by the state branch of the American Cancer Society, for the years 1946-47. The purpose was not to suggest or modify the generally accepted methods of diagnosis and treatment used today, but rather to reemphasize the magnitude of one phase of the cancer problem, namely, early recognition and treatment. We wished to confirm our own impressions of the type of cases we were seeing, and more important than anything else, bring to the physicians of our area a report of the situation as seen at one of the final disposition centers for cancer in this state. It was realized at the outset that the statistical information gained herein would not be pretty but that the situation had to be faced and more emphasis placed in quarters needing it most. It is hoped similar studies can be made on other cancer sites such as the breast, uterus, stomach, etc.

Epidermoid carcinoma is by far the most common type of malignancy found in the cervix. It is twenty to one more prevalent than adenocarcinoma, the other carcinoma found in this site. Sarcoma occurs rarely. In the 71 cases studied in this series there was but one adenocarcinoma and one sarcoma, the remainder were all gradations of epidermoid carcinoma (Table 1). Clinically the pathologic type could not be distinguished from the gross appearance of the lesion.

TABLE 1

Epidermoid	69
Adenocarcinoma	1
Sarcoma	1

Cancer of the cervix is the most important of gynecologic diseases. Despite recent advances in the surgical care of patients such as penicillin, sulfa, plasma, etc., there has been little change in the methods of treatment of this disease in the past twenty years and the five year survival rate has shown very little improvement. Approximately 17,000 women die annually of this disease,¹ with cancer of the uterus comprising 30 per cent of cancer in females and 75 per cent of uterine cancer occurs in the cervix.² As to symptomatology it is of comparatively little value in the early diagnosis of

From Gamble Brothers and Archer Clinic, Greenville, Miss.

this condition. It is known that cancer of the cervix will run its course for a considerable length of time before any symptoms occur that will excite the patient enough to seek a physician. C. MacFarlane³ has done a monumental work in publicizing the value of periodic examinations in women of the cancer age and in the first thousand examinations she made, 4 malignancies of the uterus were found in addition to 357 benign conditions many of which may have had malignant potentialities. With the development of contact bleeding, malodorous discharge, and later continual bleeding the lesion is usually in a fairly well developed stage and should surely excite the patient enough to visit a physician whose suspicions should be aroused enough to suspect the nature of her disease.

I make this point because in this relatively small series of 71 cancers of the cervix, 4 had been treated by their local physicians for from three months to two years before the nature of the disease was found and 3 of the 4 had not had the benefit of a vaginal examination. Six had hysterectomies prior to their admission for abnormal bleeding and 5 of these operations had been performed two years or less before these patients were seen by us. To make matters even more confusing 2 of our patients, both Grade IV, had been examined in our own clinic approximately one year before a diagnosis of cancer was made. Needless to say this latter condition has been largely corrected.

All of the patients reporting here complained of bleeding of some degree, varying from spotting to frank hemorrhage (Table 2).

TABLE 2
First Symptoms Noted

Bleeding	51
Discharge	14
Pain	6

Thirty-seven had less than 8 grams of hemoglobin upon admission. Forty-three complained of loss of weight. Discharge was a variable complaint unless the condition was far advanced when it assumed large proportions. Six complained of pelvic pain as their chief symptom although many others had some degree of pain. There was but one admitted with vesicovaginal fistula.

Heredity. There were 2 patients whose mothers had died of cancer of the womb. No others gave a history of cancer in the family.

Parity. There were 3 women in this group who had not borne children. The average number of pregnancies for the group as a

whole was 4.6. There were 2 patients who developed their symptoms in the immediate postpartum state.

Age. Ages varied from 17 to 93 (Table 3). Approximately 60 per cent were in the 40 to 60 year group. Those in the 20 to 40 year group and the 60 and above were about equally distributed.

TABLE 3
Age Groups

<i>Age</i>	<i>No. of Cases</i>
Under 20	1
20-30	3
30-40	13
40-50	23
50-60	19
60-70	10
70-80	1
Over 80	1

Menopause. Of this group 70.4 per cent were past the menopause when their symptoms developed. Six of these were as a result of surgery.

Color. There were 19 white and 52 colored.

Duration of Symptoms. The average duration of symptoms as given by the patient for the group as a whole was 12.6 months. In an attempt to correlate the progress of the disease with the duration of symptoms this was broken down into grades (Table 4).

TABLE 4
Duration of Symptoms

	<i>Cases</i>	<i>Months</i>
Grade I	4	5
Grade II	11	6.9
Grade III	9	9.6
Grade IV	47	13.3
Group as whole	71	12.6

This, of course, makes no important revelation and is only a basis for further effort to educate the public to seek a physician for an evaluation of symptoms.

Diagnosis. The methods of diagnosis used in our clinic are the simplest probably because by the time we see the patient there is little to tax the diagnostic acumen in determining the nature of the lesion. It is rather obvious from the mortality we have had in the last 2 years that this group was predominantly Grade IV. Approx-

imately 66 per cent of 71 cases were Grade IV with only 5 per cent Grade I (Table 5).

TABLE 5
Grade at Admission

	<i>Cases</i>	<i>Per Cent of Total</i>
Grade I	4	5
Grade II	11	15.4
Grade III	9	12.6
Grade IV	47	66.1

We do not use the Schiller or Chrobeck tests and do not possess a colposcope. In this series there would seem to be little use for cytologic examination after the method of Papanicalaou as the diagnosis was obvious. However, we have not as yet utilized this technic in cancer detection. All were confirmed by biopsy and in this respect we routinely make a biopsy from any suspicious lesion of the cervix. As stated above in this series the biopsies made were only confirmatory as there was little doubt as to the nature of the lesion. There were 4 patients who came to us shortly after biopsies were taken at which time a positive diagnosis had been made. We did not notice any deleterious effect from this procedure having been done prior to admission. Two hysterectomies were done that were included in this group because of the suspicious nature of the symptoms after there had been a negative report from uterine curettements and an early carcinoma of the cervix discovered in this specimen. TeLinde has recently reported 35 such cases.⁴

There was recently a patient in our clinic who had a total hysterectomy following a cervical biopsy reported as probably malignant. As it turned out there was justifiable pathology for the hysterectomy but in a restudy of the sections the true diagnosis was found to be a squamous cell metaplasia. This is a not infrequent error.

I am apologetic in stating that this group of 71 cases represents only a study of the cases our clinic has handled for the years 1946-47. Our hospital has no resident staff and during the heavy load carried in the war period very poor if any records were kept. As previously stated the purpose of this study was to report the status of the cases we are at present seeing. These cases have all been followed at regular intervals and those surviving are still under observation and an accurate record has been made and is being maintained. The object of this study was to determine what we had salvaged from a group of cases, the majority of which were hope-

less when first seen, and to draw to the attention, if possible, of the referring physician what the outcome of an incomplete initial examination means in terms of malignancy. Approximately 14 per cent of these patients visited a physician with complaints referable to the uterus three months to two years prior to admission to the hospital and ended as a Group IV cancer of the cervix. One cannot help but feel that they were cheated out of at least few percentage points' chance of survival.

Twenty-nine of the 71 patients have died and on the basis of recent follow-ups and correspondence with relatives and physicians 8 have but a short period to survive. This is a mortality of 40.8 per cent in a two year period. One is at present hospitalized for a recurrence in the pelvis and 3 are now hospitalized for a second course of deep x-ray with far-advanced pelvic involvement and yet another has recently been hospitalized for radium implantation in the broad ligaments. Three have recently been hospitalized for colostomies in an effort to control severe rectal pain because of carcinomatous involvement. Thus we might add 7 more whose survival for any period is doubtful. As a purely problematical statement it is expected that this series will show the expected five year survival rate of from 15 to 25 per cent.

TABLE 6
Deaths by Grade

	No. Cases	X-ray and Radium Treatment	Death	Opera- tion	Death
Grade I	4	0	0	4	1
Grade II	11	4	0	7	2
Grade III	9	7	1	2	2
Grade IV	47	40	18	7	6
Totals.....	71	51	29 (37.2%)	20	11 (55%)

There were 20 patients operated upon with a mortality rate of 55 per cent (Table 6). Fifty-one were treated with x-ray and radium with a mortality of 37.29 per cent. I believe that the high mortality rate with surgery requires some defense. In simple terms it was a heroic effort against almost hopeless odds. These patients came to us for the most part in not only a far-advanced state but anemic, malnourished, and having lost weight. Two of the operative deaths were in patients who had preliminary x-ray and radium and for some reason did not show a satisfactory response. The type of operation done was a cauterization of the lesion with a Percy

cautery. The use of this type of procedure in itself is probably an admission that the case was hopeless. Neither patient lived to leave the hospital but both lived longer than four weeks and death was by inanition. Both were Grade IV cases in the beginning.

There were altogether 7 operations carried out upon initially Grade IV carcinoma. Only one patient is living today and she still has carcinoma that will eventually take her life. There were 5 vaginal hysterectomies done in this group. I make no effort to condemn nor praise this procedure. All had had x-ray and radium.

There were 2 operations carried out upon Grade III carcinoma, both being resection of the uterus and rectum. One was done without prior x-ray and radium and one with. One died in the hospital and at postmortem there was no cancer found remaining and the death was due to acute glomerular nephritis. This patient had previous x-ray and radium. The other died four months after leaving the hospital with widespread metastases.

Seven of the Grade II cases had vaginal hysterectomies with 2 deaths. The deaths occurred several months after leaving the hospital of recurrent cancer.

All 4 of the Grade I cases were operated upon with one death. This death occurred one week after operation. The type of procedure done is a vaginal hysterectomy leaving the broad ligaments clamped for 72 hours and packing the peritoneal defect with vaseline gauze. The nurse instructor inadvertently used this patient to demonstrate how to give a douche and she died two days later of a virulent peritonitis.

SUMMARY

1. Seventy-one cases of carcinoma of the cervix are reported with a follow-up of three months to two years.

2. Twenty-nine have died and 8 are still being observed with a problematical death within the year and there are 7 others, either hospitalized or only recently discharged, who are in the same category. Thus there has been an absolute mortality of 40.8 per cent in two years with a problematical mortality rate of 61.8 per cent in three years.

3. Fifty-one were treated with x-ray and radium alone with a mortality rate within the two years of 37.2 per cent.

4. Twenty were treated either with surgery alone or combined x-ray and surgery with a mortality rate of 55 per cent.

5. The average duration of symptoms was 12.6 months before

initiation of treatment. In the more extensive cases the duration of symptoms was longer.

6. Of these patients 14 per cent were seen by a physician because of symptoms referable to the uterus three months to two years prior to a positive diagnosis.

7. It is my belief that the five year survival rate of the group will be within the average although this is purely problematical.

8. High occurrence in menopause should be reemphasized; 74.4 per cent occurred in menopause.

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THE PLASTIC REPAIR OF INJURIES TO THE MALE GENITALIA

W. G. HAMM, M.D., F.A.C.S.

and

FRANK F. KANTHAK, M.D., F.A.C.S.

Atlanta

INJURIES to the male external genitalia were comparatively common among the men of the armed forces during both World War I and World War II, although fortunately they occur with much less frequency in civil practice. These wounds are not in themselves fatal, but the mortality may be considerable because of the rather frequent associated damage to neighboring structures such as the pelvis, pelvic viscera and perineum. They often militate against the patients' mental well being and this is of extreme importance.

Injuries in which there is an associated partial destruction of the urethra will not be discussed in this paper because we do not wish to invade the field of the urologist whose advice and assistance in caring for them is essential. Suffice it to say that this condition complicates an already difficult situation insofar as reconstruction is concerned.

The well-established fundamental of surgery of never sacrificing any tissue that may be viable and which may be utilized in the repair must be emphasized in the immediate treatment of wounds of the external genitalia. The next fundamental is to utilize, if possible, adjacent tissues rather than to plan skin flaps from distant sources.

The scrotum especially possesses great elastic properties and often loss of tissue in wounds of the scrotum is more apparent than real. It is frequently possible to reconstruct a scrotum from what on first inspection seems to be totally inadequate remnants. In cases where there has been a total loss of scrotal covering the surgeon has several avenues of immediate treatment but under no circumstances should a viable testicle be amputated. One method may be to implant the testicles in subcutaneous pockets in the inner surface of the thighs (figs. 1 and 2) with reconstruction of the scrotum at a later date by switching flaps of overlying skin. This necessarily requires several operative steps and, although we have felt that immediate coverage should be the objective of early treatment, in view of a patient recently seen by us (figs. 3 and 4) the thought occurs that possibly many operative steps can be saved by keeping

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Fig. 1. Total avulsion of the scrotum and a portion of the skin of the penis.



Fig. 2. Replacement of testicles in subcutaneous pockets on each thigh; split skin graft to shaft of the penis.

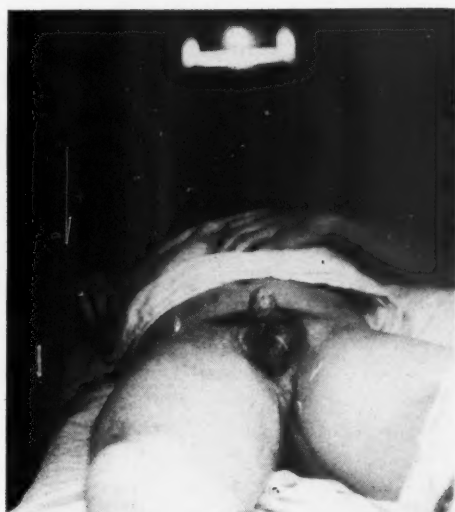


Fig. 3. Avulsion of scrotum; testicles covered with granulations; no loss of penile skin.



Fig. 4. Testicles covered by single split skin graft to granulating area.

the wound clean with constant wet dressings until the testicles have adhered in a firm mass and are covered with healthy granulations. The entire structure may then be covered with a split skin graft.

Injury to the spermatic cord is of importance in that the blood supply of the testicle may be destroyed which will result in atrophy of the testicle. If the testicle should be dislocated through a scrotal wound it should be inspected carefully, cleansed and returned if found intact. Should there be an incised wound in the testicle it should be closed by suture before returning it to the scrotum and if there is evidence of intratesticular hemorrhage the tension should be relieved by multiple punctures of the tunica albuginea in an effort to avoid subsequent atrophy. If viability of the testis is in doubt it may be replaced in the scrotum, but one should avoid closing the wound until its survival is assured and only in cases where the testis is hopelessly injured should orchidectomy be performed.

The damage inflicted in injuries of the penis varies from partial loss of skin to injuries of the corpora cavernosa to total amputation or destruction. If there should be only partial loss of the skin covering, it may be repaired by mobilizing the surrounding adjacent skin and closing the defect by suturing. Where the loss is more extensive a flap of scrotal skin may be switched over the defect and the pedicle severed after circulation in the flap is established. Scrotal skin is fairly thin and is expansile and although it contains hairs it makes a satisfactory penile covering. The penis may be placed in a tunnel beneath the skin of the thigh or abdomen and released later. However, skin from these sources, in addition to containing hair, is too thick to be advantageous. It was demonstrated several years ago by Brown that the penis may be completely resurfaced by covering with a split skin graft and certainly this is the method of choice. One might think that the graft would shrink so much as to interfere seriously with erection, but such is not the case. The end result is the nearest thing to the normal penile skin. It is soft, easily movable and erection is uninhibited and in a very short while normal sensation returns.

Cases with transverse lesions of the corpora usually heal with lateral curvature on erection. During the war reports appeared first in the Russian literature of reconstructing a functional organ by transplanting costal cartilage provided with skin covering to the remaining erectile tissue of the root of the penis or in less severe injuries to act as a splint and prevent the curvature on erection. We have had no experience with this method, although we have had occasion to observe a patient who has had a cartilage transplant for deformity following a wound of the corpora. The result was not entirely satisfactory but the patient stated it was an improvement and although he was having some frequency and evidence of urethral irritation apparently due to the pressure of one end of the graft on the urethra he preferred not to have the cartilage removed.

The almost completely severed penis can sometimes survive in a surprising manner and even if the root is destroyed the pendulous portion should be given every chance of survival. However, the reparative surgery of the penis is chiefly subordinate to that of the urethral injury which so often is present.



Fig. 5. Male infant following circumcision with high frequency electrical current; slough of penis and retraction.

It has been our privilege to see 2 cases recently, with a rather unusual type of injury to the genitalia, which we feel should be reported. These 2 patients were almost identical in every way and possibly a word of warning may prevent repetition of their condition in other patients. The patient in each case was a male infant, 2 or 3 days old. Each infant was circumcised by a doctor who used some kind of high frequency electrical current for the operation.

In the first case the doctor noticed some red streaks extending up the skin of the shaft almost as soon as he began the operation and he immediately discontinued using the instrument and completed the work with sharp dissection. On about the second postoperative day the skin of the penis became dark and gangrenous in appearance and within a week the entire organ seemed doomed. We saw the patient about this time and found only a very short nubbin of penis with secondary infection of the skin around the base (fig. 5). The glans could not be identified. The baby was hospitalized and constant moist saline dressings applied. The infection cleared within a few days and all remnant of penis disappeared. There remained only a pin-point opening in the skin surrounded by scar and the opening had to be kept patent by nicking the scar

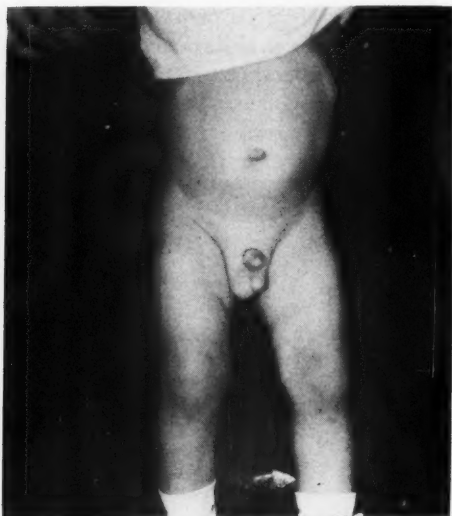
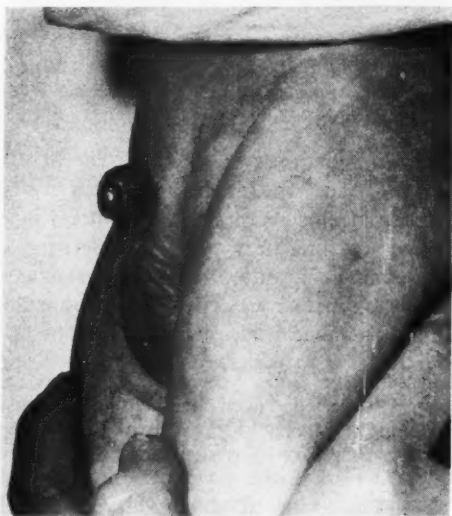


Fig. 6. Postoperative results attained on 2 patients by dissecting the corpora cavernosa and covering them with split skin grafts.



with a pointed scalpel every 2 or 3 days. We felt that the entire corpora had not been lost since we could palpate a small hard mass under the skin and at operation we dissected this mass free, cut the suspensory ligament to obtain extra length and sutured the skin margins around the base as far as possible

to maintain as much length as we could. The exposed corpora was covered with a split skin graft which was wrapped around it and held by sutures and after inserting a retention catheter a pressure dressing was applied with some difficulty since we tried to hold the penis erect so that equal pressure would be applied all around. The dressing was changed on the fifth postoperative day and there was a complete take of the graft. We saw this child recently—about 3 months later—and found the organ to be approximately normal for a child of this age. A large portion of the glans had been lost but this was not especially noticeable and we believe this child will in no way be handicapped by what at first was thought to be a catastrophe (fig. 6).

In the case of the second child the entire circumcision was performed with the high frequency machine and nothing unusual noted until the second day when the organ seemed to be becoming gangrenous and soon presented a picture very similar to the first with only a small opening through which he voided and which was surrounded by scar. A similar operative procedure was carried out.

It might be stated that both these patients were operated upon by surgeons who were using the high frequency machine for the first time but we have been unable to determine if the same machine was used in each case. We are not prepared to say just what the underlying pathology was in these patients but feel confident that it was not simply secondary infection. Possibly a thrombosis of the vessels resulted from the electrical current,—certainly an instrument of this type should not be used for this purpose.

SUMMARY

While injuries to the male external genitalia are not common, their incidence is sufficiently high and their importance sufficiently great to warrant the stressing of methods of their care.

Losses of the scrotum may be repaired by scrotal remains in incomplete losses, by burying the testicles in subcutaneous pockets of the thighs, or by covering the testicular mass with a split skin graft.

Losses of penile skin may be replaced by split skin grafts or by pedicle flaps or scrotal tissue.

Severe injuries to the corpora cavernosa may be difficult to rectify. Cartilage implants may serve to improve the sexual function of a penis which has lost much of its expansile elements.

The dangers of utilizing the high frequency current for circumcision are mentioned, together with a method of repair of penile organs damaged by such treatment.

MANAGEMENT OF CRANIAL CEREBRAL INJURIES

FRANKLIN JELSMA, M.D.

Louisville, Ky.

THIS outline is intended to cover the method of procedure in the care of patients suffering from cranial cerebral injuries, beginning in the emergency room and continuing without interruption after admission to the hospital. It is hoped that it may serve as guide for the house staff and resident staff to permit a more careful direction and treatment of the patient in the emergency stage, as well as in the final definitive stage when such treatment is necessary.

One of the most frequent and troublesome problems confronting the doctor in the emergency room is to decide which patient with cranial cerebral injury should be admitted.

1. All patients who have been unconscious should be admitted for at least 24 to 48 hours' observation. Those who are more seriously injured, of course, must remain until their condition permits release from the hospital.

2. All patients who have wounds necessitating suture must be admitted and observed through the stage of possible infection, while prophylactic treatment is administered.

3. All patients in whom there is any question about their status should be admitted. This includes the individual who has had a trivial injury but presents evidence of some dysfunction, some slight change in consciousness, with some progression of these symptoms, plus headache. These symptoms might point to a developing EXTRA-DURAL HEMATOMA, which is a very serious and acute problem.

I. EMERGENCY TREATMENT

The emergency treatment begins immediately upon arrival of the patient in the emergency room.

A. Shock. The first condition demanding care is hemorrhage. Further efforts to combat shock should be instituted immediately by the doctor on duty; consisting of lowering of the head, stimulants, such as caffeine sodium benzoate, and maybe even a small dose of morphine (an eighth) if given with an ampule of prostigmine 1:2000. Plasma should be started in the emergency room and not delayed until later, and the man on duty should notify the member of the resident staff, on whose service the patient is going, that the patient is on his way into the hospital and conduct him to his room

From the Department of Surgery, University of Louisville School of Medicine, and St. Joseph Infirmary.

along with the record made in the emergency room, which is handed over to the house officer taking charge of the patient in the hospital. There should be no delay in the transmission of this patient's care from the emergency room to the house service. If needed, blood should be arranged for immediately and by the officer of the emergency room if expedient. Seldom will closed injuries require blood. External injuries may require transfusion.

B. Control of bleeding. Bleeding should be controlled immediately by hemostats or Michel clips along the edge of the scalp wound. Hemostats are preferable, if further operative procedure is to be performed in the emergency room. Michel clips can be placed and a compression bandage applied, and patient sent up, after the notification of the man on the service to which the patient is going, so other arrangements can be made for immediate care of the condition present. In case of extensive laceration, this would save considerable time for set-up of the operative facilities.

C. Care of abrasions and lacerations. Abrasions should be cleansed with soap and water, and compound tincture of benzoin applied. Lacerations that have not extended through the galea should be sutured in the emergency room, if desirable. Those lacerations that extend through the galea should be cared for as a major operative procedure, as far as sterility and equipment are concerned. It is not necessary to use a major room, but one should have cap, mask, gloves, gown, with a perfectly prepared operative field and complete sterile technic. This is because subgaleal infection may develop and result in such serious problems as meningitis, brain abscess, etc. The prevention of such conditions is the proper treatment.

The lacerations NOT extending through the galea are attended to as follows: The field is prepared by shaving around the laceration two inches from each border. Proper cleansing with soap and water followed by aqueous methylate or ST37. Novocaine 1 per cent is used. It should be remembered that the blocking of the supraorbital nerve with novocaine would give a complete and perfect anesthesia of the scalp on that side, including and extending from the forehead back to the anterior parietal region. Otherwise, infiltration with novocaine is performed without introducing the needle into the laceration but by introducing the needle about a centimeter or two from the edge of the wound. Through and through silk stitches are used on curved cutting needles. Dressing is applied using liquid adhesive and sterile gauze, or collodium, or bandage, if pressure is desired. This patient should be referred back to the family doctor for care, and a note sent to him indicating

when the stitches were placed, and whether tetanus or gas antitoxin had been given. The latter is an individual problem.

D. *Record.* A record should be made and filed in the emergency room if the patient does not enter the hospital, but if the patient enters the hospital this record should accompany the patient to his bed. It should be made immediately and should contain the time of day seen by the man on emergency service, time of injury, pertinent details in regard to how it happened, gross evidence of injury, the degree of shock (systolic blood pressure of 100 or over doesn't indicate shock of any degree), the blood pressure, pulse and respiration. The degree of consciousness should be noted. This is determined by talking to the person. One can say he responds, he is rational or irrational, or that he does not respond to questions. A uniform method of stimulus for an unconscious patient is to squeeze the thigh on the mesial aspect, and if he does not respond one can say he will not respond to stimulus, or that he responds a little or readily. That would indicate the degree of unconsciousness. Also, on this record should be noted any evidence of focal injury to the brain, such as, paresis or paralysis in one or both extremities, spasticity, flaccidity, tremors, convulsions or pupillary changes. Further, record should be made whether patient has bleeding from any of the orifices and, finally, whether or not he was given any stimulants in the emergency room, or any other drugs, including antitoxins.

II. HOSPITAL TREATMENT. *Definitive treatment*

A. Continuation of the emergency care of the patient is carried out by the house officer assigned to the service on which the patient is admitted, plus one of the residents in surgery or neurosurgery. Continued treatment of shock is carried out until the patient has recovered from shock. Then further emergency care is begun. Suture should be performed of lacerations that have penetrated the galea, however extensive, that are NOT accompanied by fractures with evidence of depression, or fracture lines with gross objects, such as hair, cloth, etc., enmeshed. The technic for the suturing of the scalp is the same as used in the operating room, for surgical wounds. The head is prepared by shaving of the scalp 2 to 3 inches around the area, giving ample room. A local anesthesia, 1 per cent novocaine with 3 drops of ephedrine per ounce, is used for infiltration, 1 cm. from the margin, after the scalp has been cleansed with soap and water, aqueous methylate or ST37. Cap, gown, mask and sterile gloves are used, and the emergency tray used in cases where the procedure will not require more instruments. A debridement is performed on the scalp. Hemostats are placed

on the galea and bleeders are desiccated with Bovie, care being taken not to desiccate the skin. Suturing is then begun with interrupted silk in the galea about 1 to 2 cm. apart. This will control oozing and give approximation. Silk skin sutures are placed with straight needles. Penicillin is used in the wound. Patient is placed on adequate penicillin therapy.

(A note should be made here in regard to the initial inspection of the wound. Sometimes it is not always possible to see the skull, so a gloved finger is used when the patient first goes to the operating room, and the deep surfaces of the wound and skull are palpated with this sterile finger to determine whether there is any depression of bone. If a depression of the bone is present, the procedure should be delayed until a full set-up for intracranial surgery has been completed. The Visiting Neurosurgeon should be so notified.)

B. X-rays. X-rays are taken of the head with the injured surface down, also anteroposterior and posteroanterior plain. If the patient is in shock and demands further care in this regard, ordinarily the x-rays can be delayed. The only reason for immediate x-rays would be to determine whether or not there is any question about depression of fragments of the bone in a closed case, or to determine whether the fracture lies across the middle meningeal artery, in case of suspected extradural hemorrhage. Then these films should be taken, regardless of patient's condition, because the definitive treatment will depend upon diagnosis, and the films will be helpful in making this diagnosis. Information of simple linear fracture is not usually necessary in the way of treatment.

C. General survey. After shock has been controlled, bleeding and suturing of all wounds have been completed, then the survey of the patient's general condition should be made; the effects of the injury should be noted and the extent of the injury should be determined. A complete physical examination should be carefully done. In many cases even x-rays of the neck and spine or extremities will be indicated for possible injury.

The blood pressure should be taken as frequently as indicated, sometimes every hour, and recorded on the chart. Pulse, temperature and respiration should be taken regularly, sometimes every half to one hour, or less frequently, as the case may demand. If the blood pressure is gradually becoming higher, and the pulse becoming slower, increased intracranial pressure is developing. Initial temperature of 102 would indicate considerable cerebral damage. Respirations may vary according to the degree of increased pressure. They usually become deeper as the pulse becomes slower and fuller. However, direct injury to the medulla may produce a

respiratory irregularity or failure. Respirations vary with the pulse and temperature. The red blood count should be secured, in cases where considerable blood has been lost, and preparation for transfusions made.

D. Neurologic study.

1. *Cranial Nerves:* The cranial nerves are of considerable help in the determination of the condition of the patient and type of injury that may exist. The III, IV, VI and VII are of particular value. Pupils are of considerable help. A direct injury to the base may cause immediate pupillary change, which, when one consults the emergency record and finds the patient entered with pupillary change which is still present, he would be justified in concluding that the pupillary change is due to local damage (rather than progressive hemorrhage) to the III nerve or its central representation. Usually the pupil is larger on the side of brain damage. It may react sluggishly on one side, as compared to the other. This would indicate a dysfunction on the same side, and, if progressive, may indicate a hemorrhage on that side. Fixed, dilated pupils are a grave prognostic sign. Eyes that wander in all directions and do not deviate normally together, indicate a degree of unconsciousness, or maybe even a III, IV or VI nerve damage, which can be observed by closer observation of the movements of the eyes. The VI nerve is frequently injured in basilar skull fractures. Partial facial paralysis (lower part of face and mouth) indicates a contralateral cerebral lesion, while a weakness of the entire face indicates a nuclear or peripheral VII nerve lesion. Injuries to the back of the head and petrous region, with bleeding from the ears, are oftentimes accompanied by tinnitus and a diminution or loss of hearing, as well as dizziness.

2. *Cerebrum.* One should compare the state of consciousness, as listed on the record from the emergency room, with the state of consciousness at the time of examination, to determine whether the patient is less stuporous or more stuporous, and note the time interval, because it would indicate the acuteness of the lesion, such as in hemorrhage. Any evidence of paresis or paralysis of the extremities should be noted, and also the record of the emergency room checked. Increase of spasticity, clonus or tremor of any of the extremities, should be noted and a close watch kept for signs of progression. Agnosia, apraxia and aphasia should be noted. Record any variation in visual or auditory reception or any alteration of gross or detailed fine movements, as well as speech variations. Convulsions, focal or generalized in character, should be noted. To combat these, sodium luminal, 3 grains for an adult, or

slightly less for children, should be used. Spinal fluid or blood coming from the ears, nose and mouth should be noted. No attempt to place cotton in the external canal should ever be made. A few drops of penicillin occasionally in the ear, with sterile gauze loosely over the ear and sterile towel over pillow, will be of value. It is well to allow the head of the bed to be flat in these cases, and not permit the patient to elevate the head.

3. *Spinal puncture.* Usually spinal puncture is not of value in the early stages of care of cranial cerebral injuries. In the fulminating cases, it may be well to do a spinal puncture to determine the pressure and the amount of blood present and even to allow some of the fluid to be removed. The Queckenstedt test should not be done when the pressure is over 200. Ordinarily, spinal punctures are only for diagnosis and for draining out of the bloody spinal fluid, or blood that has disintegrated in it. Puncture should never be done when spinal fluid is draining from the ears or nose.

4. *Brain stem.* The lower cranial nerves will be involved in brain stem injuries, but usually the pulse, temperature and respiration give the most important clinical signs. When the medulla has been damaged, the pulse, temperature and respiration all will be elevated. If it has been damaged badly, they will all be considerably elevated. Respiration may be irregular.

5. *Reflexes.* Lack of deep reflexes would indicate lower motor neuron damage or shock. Usually they are increased if the brain has been damaged. Clonus, Babinski, Gordon and Oppenheim may be present also. The degree of rigidity of the extremities should be noted. Abdominal and epigastric reflexes are important. They are central and not spinal. They are usually absent on the side opposite to the injury or lesion of the brain, yet if the patient is in shock they will be absent on both sides.

E. *Diagnosis.* The diagnosis is evident, as far as open injuries are concerned, by inspection, observation and x-rays. But for the closed injuries of the head, such as the damage done to the brain and intracranial structures, one would have to study the case carefully many times, and compare the neurologic notes from time to time. Possible injuries to the brain are:

1. *Concussion.* This indicates a cerebral disturbance, without organic change, and is indicated by loss of consciousness for a brief time, and with retrograde amnesia, but no objective findings.

2. *Contusion.* This is a bruise of the brain and may be slight or may be severe, + to ++++. Necessarily, there will be local changes with contusion of the brain and the symptoms will depend

upon the location and extent of the contusion. If in the frontal region, there will be frontal lobe changes; if in the temporal region, temporal lobe changes; if in the base there will be basilar signs; in the occipital region, visual changes, etc. Again, depending upon the degree of contusion and accompanying generalized brain damage, one will have increased intracranial pressure. This is denoted by disturbance in consciousness, headache, nausea and vomiting, rise in blood pressure, slow pulse, increased temperature and increased spinal fluid pressure.

3. *Laceration of the brain.* Laceration of the brain is a contusion, plus a tear of the brain tissue. Symptoms are focal and dependent upon the location of brain damage and upon the degree of injury. Increased intracranial pressure will be present. Signs will depend upon the amount of swelling, bleeding, etc., and will present the same findings as in contusion, plus fulminating and sometimes focal signs due to bleeding.

4. *Hemorrhages.* Hemorrhages may be one of several types.

a. *Extradural.* The extradural hemorrhage is caused mostly by bleeding from the middle meningeal artery. This is one of the most acute conditions that we have to contend with in the field of cranial cerebral injuries. The patient must be cared for surgically in the first few hours, not later than 10 to 12, or he will expire. The symptoms are rather uniform in development. There is a history of slight injury, with usually a lucid interval, and then headache, nausea and vomiting, followed by progressive and increasing disturbance of consciousness, with stupor, drowsiness and coma. At the same time, there will be developing a change in pupillary response, a gradual paralysis of pupillary action, with dilatation on the side of the lesion. Motor weakness with increasing paralysis on the opposite side will be noted, and increased reflexes will be present, with clonus and rigidity. As the clot increases, consciousness rapidly fades into a deep coma, accompanied by stertorous breathing and medullary changes as the pressure increases.

b. *Subdural hemorrhage.* Bleeding occurs from the veins that pass between the dura and brain, and is always of venous nature, and is of an insidious character. Slight injury may produce it, and the patient show no immediate effects of the injury. Or it may be seen in more severe injuries with more severe brain damage. In the chronic cases, and they are many, the subdural hemorrhage remains dormant for a while; and then there will be intractable headache, psychic changes, mental and personality changes, and even changes in the degree of consciousness, and eventually coma.

It must be removed, along with the encapsulating membrane, but this is usually elective.

c. *Subarachnoid hemorrhage.* This may accompany laceration of the brain, or contusion of the brain. It indicates there has been a blood vessel ruptured beneath the arachnoid and is usually cared for as such by draining off the spinal fluid at regular intervals. However, it is necessary to consider the accompanying damage to the brain.

d. *Intracerebral hemorrhage.* This may occur from injury, and consists of bleeding within the brain substance, but not usually in the capsule, which is commonly called apoplexy. It is usually in other parts of the brain, producing symptoms much as in brain tumor, the difference being a history of injury and of gradual progressive change, depending upon the location of the hemorrhage. Removal may be indicated.

e. *Cerebral edema* consists of disturbance of absorption of spinal fluid, as a result of injury, because of disturbance of mechanics; because of blood accumulating in the spinal fluid, and slowing of absorption at the pacchionian bodies, or due to other reasons. It should be cared for by drainage of the spinal fluid, restriction of fluid, etc.

The course of treatment has been indicated. The details of procedure have not been mentioned, because the operative technic for craniotomy—bone flap, etc., are well standardized and need only be adapted to the individual case. Neurosurgeons are familiar with the necessary procedures. The above discourse is planned primarily as an aid for the house staff and the resident personnel of a well-organized hospital staff, in the hope that it may facilitate the desired direction of the patient, and that necessary and adequate treatment may be administered to those individuals with cranial cerebral injury.

INCORRECT KNOT-TYING, CAUSE FOR BROKEN SUTURES

SIMON V. WARD, M.D.

New Orleans

A FREQUENTLY overlooked point of surgical technic is the fact that a suture, even though tied correctly, if pulled in the wrong way is markedly weakened and will break while the knot is being tied. Every surgeon who has studied the principles of knot-tying realizes that a suture "pulled across itself" is weakened. But many men do not apply this principle in actual practice as, I believe, they do not realize the amount of tensile strength lost by the incorrect pull.

I am therefore attempting to review the principle of the correct pull in setting a knot, and to present by a series of test pulls the amount of tensile strength lost if this principle is not observed. Repeatedly while assisting in the operating room I have observed experienced surgeons inadvertently breaking their ligatures; almost invariably it happens when the knot is not pulled correctly. Time and time again surgeons complain to the suture nurse that she has given them the wrong size catgut, that the sutures are defective, or that they were served "Wheaties for breakfast."

In a review of the literature and textbooks on surgical technic, only a few references have been found to the value of pulling the square knot correctly as it is tied. These are invariably based on the fact that such a tie has greater holding power; no mention could be found in the literature of the weakening effect of an incorrectly pulled knot on a suture, increasing the chance of inadvertently breaking it as the knot is pulled across itself. Livingston¹ stresses the importance of the straight pull in bringing out the point that the square knot is called the "flat knot." He says,

"The reason why square knots are synonymously called 'flat knots' is that when properly tied both simple components lie in one plane. It is essential to the security of this tie that account be carefully taken of the plane in which the knot is created. No reference to this fact is found in surgical literature. The fact that textbooks dealing with surgical technique repeatedly illustrate square knot ties which are of a twisted and insecure variety further attests to the neglect of this important matter."¹

Goldberger² describes a method of one-handed square knot tying which obviates crossing the hands to set the knot correctly. Taylor describes the incorrectly set knot as "quite useless."³

If the suture ends are crossed before making the first throw, or

before it is tightened down, the result will be a straight pull (fig. 1). However, if the ends of a ligature are held without crossing them,

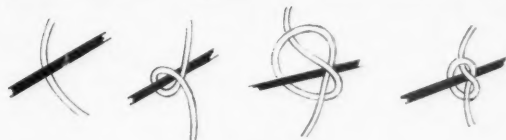


Fig. 1

and the knot made and pulled down without crossing the hands or crossing the suture, the result is seen in Figure 2.



Fig. 2

The difference here is NOT to be confused with the difference between a square versus a granny knot, since the first half stitch is made the same in either case. We are concerned here with the way this first half-a-knot is pulled down, or set.

In Figure 1, the pull is straight with the suture, and such a knot does not weaken a ligature appreciably. In fact, when weights are added to the breaking point, in actual testing sutures over this type of knot, the suture rarely breaks at the knot, but rather at any slightly weakened point along the tested area. Consequently, the full benefit of the strength of the suture is obtained when a "straight" pull is made in "setting" the first knot.

On the other hand, when the pull is made as in Figure 2, which occurs when the suture ends are not crossed before the knot is set, there is a decided weakening of the suture. Taylor describes this as "a square knot which is quite useless. The throw has not been pulled flat. This is frequently the type of square knot tied with one hand when care is not taken to cross the hands between throws and exert equal tension on each strand."⁴

As has been brought out, therefore, by Goldberger, Livingston, and Taylor, the poorly set first throw results in a square knot with poor holding value. However, it is also true that only a relatively small percentage of the tensile strength of the suture may be used in tightening down, or setting, the first throw, lest the suture break. The percentage of decrease of strength may be readily demon-

strated by a series of weight tests of various size sutures over knots pulled straight (fig. 1) and those pulled with the suture pulling across itself (fig. 2). Table I shows the results of a series of such tests indicating in pounds and ounces the tensile strength of the sutures and the percentage of tensile strength utilized if the knot is pulled incorrectly.

TABLE I

Average tested tensile strength of sutures when knots are pulled correctly, as in Figure 1, and incorrectly, as in Figure 2.

		Correctly pulled knot (lbs.-ounces)	Incorrectly pulled knot (lbs.-ounces)	Effective Percentage of tensile strength (when knot pulled incorrectly)
Chromic catgut	#2	14'12"	8'12"	59%
	1	13'0 "	6'14"	53%
	0	9'2 "	5'8 "	60%
	00	7'7 "	3'0 "	40%
	000	5'14"	2'8 "	42%
	0000	3'6 "	1'8 "	44%
Plain catgut	#2	12'3 "	6'3 "	51%
	1	9'8 "	4'14"	51%
	0	6'11"	3'11"	55%
	00	4'6 "	2'11"	61%
	000	2'15"	2'4 "	76%
	0000	3'1 "	1'8 "	49%
Surgical cotton	#00	6'9 "	4'11"	71%
	000	2'13"	2'1 "	73%
	0000	2'7 "	1'12"	72%
	#00	6'5 "	4'3 "	66%
Silk	000	3'7 "	2'3 "	64%
	0000	2'0 "	1'9 "	78%
	#2	10'15"	6'5 "	58%
Dermol	1	7'15"	2'9 "	32%
	0	5'8 "	3'13"	69%
	00	3'14"	2'6 "	61%
	000	3'7 "	1'6 "	40%
	0000	1'8 "	1'1 "	71%

In this series of tests the more commonly used sutures have been employed. These tests were carried out by securing one end of a suture to a round bar, tying the suture over a small round rod and then to a weight carrier; first a straight-pulled, or correctly set half-hitch was used, and second an incorrectly set knot was tested. Weights were added in each case, and there was invariably a marked decrease in the amount of pull required to break the bad knots. Several tests were run on each size suture until a good check was

obtained and an average was taken. Several tubes or spools of suture were employed in each case, while both good and bad knots were tested from each sample to prevent individual variations of the suture material from affecting the results.

Let us consider, for example, the results seen in testing chromic catgut, which averages exactly 50 per cent as strong when pulled across itself as when pulled straight. Reference to the table reveals that chromic catgut #1, pulled correctly, will stand 13 lbs. pull, clearly adequate tensile strength. However, if the first knot is a ligature of chromic #1 pulled across itself, it will break with less than 7 lbs. pull (53 per cent). This means that less pull can be put on a #1 catgut ligature in this way than can be used on #00 if pulled correctly. It can therefore be seen throughout the series on chromic catgut that the bad knots reduce the tensile strength of the suture by two sizes: #1, pulled incorrectly, is about equal to #00 pulled correctly; #0 pulled incorrectly about equals #000 pulled correctly, etc. From this it follows that if chromic 0 is used for a given ligature, pulled incorrectly, and NOT broken, the chromic 000 would have served equally well.

The same applies to a lesser extent to the pull of the second half of the square knot. It is of less importance, however, as the knot will twist itself after the hemostat or clamp is removed, thus righting itself, at least in part. Furthermore, the second and third throws of the knot are usually not tightened down to as nearly the full tensile strength of the suture, as is the first.

Not to be overlooked is the other well-known reason for pulling the first knot correctly. If the first knot is pulled incorrectly, after the second half has been completed and the suture ends cut or released, the knot rights itself as the elasticity of the suture makes it seek its shortest circumference. Thereby the knot loosens itself after tying. This may readily be demonstrated by the use of large cord, which magnifies the loosening effect. However, it is not the purpose of these experiments in tensile strength across knots to illustrate this point.

Review of Table I reveals a marked reduction in strength in all types of suture material when the knot is pulled incorrectly. The crossing of the suture ends before tying the knot or the crossing of the hands before setting it requires a bit more time and effort. This is far outweighed, however, by the reduced number of broken sutures in difficultly placed ligatures.

It has been shown, therefore, that a vast majority of all breaking of suture material can be prevented by observing the principle of correctly pulling the sutures as the knot is set.

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VASCULAR ACCIDENTS OF THE EXTREMITIES

KENNETH D. GRACE, M.D., F.A.C.S.

LaGrange, Ga.

IT is unfortunate that a second World War found us unprepared for handling the inevitable vascular injuries which a search of World War I statistics would have led us to expect. Every surgical textbook describes excellent methods of vascular suture, without the warning that they are uniformly unsuccessful or worthless in severely damaged vessels, and in the average surgeon's hands. Development of anticoagulants (which were not available in adequate amounts), antispasmodics, and sympathetic nerve interruption techniques, all of which are at best useful adjuvant therapy constituted about the only advance in therapy in injured blood vessels.

Tables I and II are a summary of results of vascular injuries of the extremities observed during the last war. These were treated in a well equipped evacuation hospital under relatively favorable conditions.

DIAGNOSIS

Diagnosis of vascular injury is usually easy, but evaluation of the extent and importance may be difficult. The obvious signs of hemorrhage, tissue avulsion, etc., are suggestive or diagnostic of an injured vessel, but two additional signs are of major importance. In the absence of nerve injury, *loss of muscle power and motion* in the injured extremity is almost diagnostic of avascularity. Warmth of the skin is misleading. It was a frequent experience to amputate a leg which had skin warmth as low as the foot, with definite blanching and return of color on pressure. The muscles would be typically moist and gangrenous, without circulation, under the nearly normal skin. Bradford and Moore⁸ stress this point, while few other writers even mention it. Circulation is adequate if the muscles of the extremity have motor power, and no attempt at restoration of blood flow need be made. The second sign, and it has a bad prognostic significance, is the tense, brawny edema which avascular extremities develop. This has become a universally recognized sign. The one case of dry gangrene mentioned above is the rare exception. When these two signs are present, unless circulation is reestablished a group of symptoms and signs are almost certain to follow. The earliest of these is a falling hematocrit and increasing anemia, which will not respond to transfusion. Shortly later the patient will become nauseated, refuse food, and become pallid. Occasionally this picture develops within 36 to 48 hours after injury, though usually it is delayed longer. When it develops, delay in amputation can be

TABLE I—UPPER EXTREMITY

<i>Number Cases</i>	<i>Initial Condition</i>	<i>Operative Procedure</i>	<i>Result</i>
1. Axillary Artery (3rd Portion)	3 No ischemia	3 Debridement and ligation	2 Normal circulation
		1 Debridement and cannula without heparin	1 Ischemia, following surgery, persisted. Death from concomitant head injuries
2. Brachial Artery A. Upper Third	2 No ischemia	2 Debridement and cannula without heparin	2 Cannulated arteries thrombosed, cannulae removed. Circulation remained normal
	1 Gangrene in 24 hrs. old injury with hematoma, and complete circulatory block	1 Initial amputation	1 Loss of limb
	1 Ischemia, extensive soft tissue injury, vessel occluded by spasm	1 Debridement, vessel stripped, stellate blocks	1 Circulatory loss. Death from cerebral embolus 4 hours postoperative
B. Middle Third	7 No apparent ischemia	5 Debridement, simple ligation of artery and vein	4 No circulatory loss 4 Gas gangrene at site of forearm injury. Amputation mid-forearm
		2 Debridement—vessels found intact but in spasm. Vessels stripped, heparin injected proximal to spastic segment, veins ligated	1 Radial pulse with full circulation in 2 to 6 hours 2

TABLE I (Continued)

<i>Number Cases</i>	<i>Initial Condition</i>	<i>Operative Procedure</i>	<i>Result</i>
C. Lower Third 6	No apparent ischemia	Debridement and simple vessel ligation	No circulatory loss Gangrene (gas) at site of humerus fracture, with amputation
			5 1
Total cases with major vessel occlusion or interruption			
Amputations			
Additional poor circulatory results, with death from other causes			
Inadequate circulatory results in percentage			
			20 3 2 20

TABLE II—LOWER EXTREMITY

A. Femoral Artery					
1. Upper Third 3	Circulatory loss	3	Primary amputation	1	Loss of limb
			*Cannula and heparinization	1	Limb viable
			Primary debridement and ligation, amputation in 48 hours	1	Loss of limb
2. Middle Third 6	Circulatory loss	6	Primary amputation	4	Loss of limb
			Debridement and delayed amputation 24-96 hours	2	Loss of limb
3. Lower Third 10	Circulatory loss	10	Initial amputation	2	Loss of limb
			Initial debridement and amputation in 24-72 hours	4	Loss of limb
			Lacerated artery repaired by suture. Amputation in 18 hours, death followed	1	Loss of limb, died
			Artery cannulated, and heparinized, subsequent amputation	1	Loss of limb

TABLE II (Continued)

<i>Number Cases</i>	<i>Initial Condition</i>	<i>Operative Procedure</i>	<i>Result</i>	
		* Artery cannulated, cannula removed, fasciotomy	Limb viable	1
		Case of simple fracture, supra-condylar, with vessel loss due to spasm	Dry gangrene, limb not viable, but not amputated	1
B. Popliteal Artery	16	Initial amputation	Loss of limb	12
		Artery cannulated and heparinized. Vessel functioned but gangrene developed in leg	Loss of limb	1
	15	Laceration of artery. Sutured-fasciotomy performed	Viable limbs	2
		Debridement, severed artery and vein ligated	Viable limb	1
C. Tibial and Popliteal Vessels	10	Both vessels injured	Loss of limb	7
		Single vessel injuries	Viable limbs	3
		No circulatory loss	Viable limbs	5
D. Femoral and Popliteal Veins	5	Debridement and ligation		

Total cases of major vessel interruption of lower extremity (excluding venous)

Amputations	45
Non-viable limb, not amputated	36
Inadequate circulatory results in percentage	1
	82

*Presented in detail later.

fatal. Toxemia from these limbs can be sudden and overwhelming, and amputation must be performed before the systemic reaction becomes too severe, or the patient will enter an irreversible shock state and die.

TREATMENT

Debridement. This is the one measure necessary in all wounds vascular and otherwise caused by war missiles both to prevent infection and to evaluate the nature of the wound. The possible exception to this may be in stab wounds more likely to be encountered in civilian practice, where an arteriovenous aneurysm might be suspected, and contamination is relatively slight. The routine administration of sulfanilamides and penicillin cannot substitute for adequate, thorough excision of devitalized and damaged tissue. Control of hemorrhage is necessary to prevent hematoma formation with possible blockage of collateral circulation, a mechanism that resulted in one upper arm amputation mentioned above. Debridement must be done with great care, preserving all collateral vessels.

Restoration of Blood Flow through Damaged Arteries. This is the ideal which can be often achieved even under crowded forward hospital conditions. Various methods have been described. The first of these is suture of the lacerated vessel or an end-to-end anastomosis of the severed vessel by suture. In the above series, one small laceration was sutured successfully, another was unsuccessful. With heparin available, a higher percentage of sutured small lacerations should be successful. Without it, relatively few will be. End-to-end anastomosis is not practicable for the average surgeon, even with heparin. In contrast to Goodman's¹⁰ and Bigger's⁴ opinion, evidence indicates that direct anastomosis or anastomosis by a sutured vein graft would rarely be successful enough in average hands to warrant its use. Most limbs, handled by the average general surgeon, will stand a better chance with complete artery and vein ligation, trusting to collateral circulation. Successful arterial suture requires training, equipment and technic seldom available.

Restoration of blood flow by the method of Blakemore and Lord,^{5,6,7} that is, bridging the vessel gap with a non-sutured vein graft tied over vitallium cuffs, was disappointing in practice. In the cases reviewed by DeBakey and Simeone⁹ amputation resulted in at least as high a percentage of cases treated in this way, as it did in other and simpler methods. Vitallium cuffs of small enough size to use on even femoral arteries were not generally available in our theatre, but cadaver practice with larger cuffs on iliac arteries

showed the technic to be far from simple. On smaller arteries it is correspondingly more difficult.

Bridging of the arterial defect by rigid tubing of various sorts has been attempted for many years, and at present it seems to offer the best possibility of success when combined with anticoagulant therapy. Mustard^{14,15} used this method successfully with heparin. Bradford⁸ used it unsuccessfully, but did not record whether heparin was used. Blood flow was maintained in several cases in the above series *when heparin was available*. Simple glass tubing, borrowed from the laboratory, cut in various lengths and cuffed on the end by heating and flanging the ends was used. The following is an illustrative case:

A young soldier was admitted approximately 12 hours after injury with a high explosive shell fragment in his left thigh, which had penetrated and avulsed the femoral artery for a distance of 2 cm., just below the profunda branch. Soft tissue damage was relatively slight, but the leg was ischemic from the knee down. The patient was heparinized, the wound debrided, and a glass cannula tied into the ends of the femoral artery, bridging the defect. Heparin in saline was injected into the distal end of the artery before the anastomosis. Pulsation was felt at once in the dorsalis pedis and posterior tibial arteries, and after reaction from anesthesia, motor power had returned to the limb and it became warm. The wound was left open, and with a little spreading of tissues the cannula was visualized in 48 hours. Blood was still flowing through with no evidence of clotting. The supply of heparin gave out after 72 hours. On the 8th postoperative day the wound was again explored, the now-clotted cannula removed, and the ends of the vessel tied. The extremity was normal except for slight edema at evacuation the 12th postoperative day.

Rigid tubing anastomosis, regardless of the type used, is worthless unless the patient is kept under strict anticoagulant control. When kept under heparin control any convenient smooth material can apparently be made to carry blood for several days, which in many cases will be sufficient to allow collateral circulation to take over. A transparent or translucent material would have some advantage over opaque metals, in that blood flow could actually be observed. Despite the fact that this is the oldest of all methods, it is still the simplest, easiest to accomplish, and most universally available. If it could serve to tide over the circulatory damage until the patient could be sent to a vascular injury center, it would serve its purpose.

Anticoagulant Therapy: Anticoagulants are essential if any attempts are to be made toward restoring blood vessel continuity. If the vessels are to be simply ligated and the collateral circulation trusted to sustain the limb, they are not indicated. Properly controlled, they do not cause excessive hemorrhage, or if they do, their

effect can be offset by transfusions, cessation of administration or the use of protomine in the case of heparin, or Vitamin K in the case of dicumarol. More recently available gelatin foam sponges might also be effective in controlling excess hemorrhage in extensively debrided wounds where anticoagulants are being used.

The method of heparin use described by Allen¹ is still standard. Briefly it consists of this: 50 mg. of heparin intravenously as soon as the condition can be diagnosed and before operation. Subsequently 50 mg. every 3 to 4 hours, keeping clotting time over 15 minutes and under 25 minutes. A continuous intravenous drip, adjusted to this dosage is the ideal method of administration. Alternatively (and if it can be secured) 300 mg. of heparin in Pitkin's menstrum intramuscularly, which will hold clotting time at a satisfactory level for 48 hours.

Dicumarol has the advantage of being cheaper and available, the disadvantage that it takes about 24 hours to become effective, its effects are variable and so must have reliable laboratory control, and its effect persists for some hours after stopping the drug. Its effect can be offset by Vitamin K intravenously. Its recommended administration: 300 mg. the first day, 200 mg. daily thereafter that prothrombin value in the blood is greater than 20 per cent. The aim is to maintain the value at 10 per cent to 30 per cent. The use of heparin until dicumarol can become effective is a practical combination as long as heparin is so expensive and relatively hard to get.

Fasciotomy: This is a procedure which has been given very little place and perhaps too little importance in the treatment of vascular injuries. Mason¹³ believes it valuable. DeBakey and Simeone⁹ state that the general opinion of the procedure was unenthusiastic. There is practically no mention of it in the literature otherwise. It has a sound mechanical advantage. Ischemic muscles almost inevitably become swollen and tense, which, under the constricting fascial envelope, will further reduce the chance of collateral circulation reaching the area. Incision of fascial sheaths releases the constriction, and allows remaining circulation to function more efficiently. The following case illustrates this point:

A young prisoner patient was admitted about 24 hours after a shell fragment injury involving the femoral artery and vein, and soft tissue, in the lower third of the thigh. The leg was typically ischemic, though not otherwise badly damaged. At exploration and debridement a glass cannula was inserted to bridge the gap in the artery. Heparin was not available for this patient. The circulation improved temporarily, but shortly failed again, and the typical cold extremity reappeared. The patient was returned to the operating room, the obstructed cannula removed, and the vessel tied off. The leg was then incised from the popliteal space to the Achilles tendon with the

idea of resecting avascular muscle bundles, with the hope that some muscle tissue might be salvaged. When the fascial envelope of the calf muscles was incised the muscle appeared typically gray and inert, but herniated through the fascial incision. Almost instantly the muscle resumed a normal color and became contractile. Following downward, the same thing happened to each individual muscle when its less dense envelope was incised, until at the conclusion of the operation all the muscle appeared viable. The leg was put up in a bivalved padded cast. After reaction from anesthesia the foot and leg muscles could be moved voluntarily again, and the skin had good color and warmth. Four days later an attempt was made to close the incision in the skin, but retraction of the skin and still present edema prevented closure. If this limb did remain viable, skin grafting must have been necessary to close the defect. When the patient was evacuated on the 12th day the foot and leg looked viable, the color was good, and there was excellent motor power.

A second case with an unsuccessful suture of the popliteal artery showed the same end results after fasciotomy. It is regrettable that this procedure was not tried more universally so more accurate opinions could have been formed as to its value. The main argument against its use seems to be the possibility of disturbing collateral circulation carried by the skin, which is unimportant.

Sympathetic Block and Lumbar Sympathetic Ganglionectomy: These procedures base their rationale on causing vasodilation by either temporarily or permanently interrupting the sympathetic vasoconstrictor effect on blood vessels. Properly performed novocaine sympathetic block will cause a distinct skin warmth in extremities with damaged major vessels, most of the time. In this series, its use was routine. Occasionally, even spinal anesthesia was given to insure the block, or alcohol, intracaine-in-oil and other variations which prolong the novocaine effect were used. Sympathetic interruption alone did not appear to make the difference between salvage or loss of any of these limbs. Ganglionectomy as described by Mason and Giddings,¹³ seems too formidable a procedure for the benefits apt to be derived. Ganglionectomy by either the abdominal approach, or the Smithwick lumbar approach is a major procedure which would probably add to the mortality in some cases. The majority of vascular injury cases have major injuries elsewhere, and the addition of a procedure of this size might be sacrificing a life in an attempt to save a limb. Sympathetic block by any means is only a useful adjuvant to more essential procedures. It has its greatest usefulness, not in the cases of vascular injury, but of vascular embolism and thrombosis to be considered later.

Concomitant Vein Ligation: This is a controversial subject with insufficient evidence to substantiate either view. The majority of this series had suffered severance of both the artery and vein, and it was no problem in them. Most of the veins still patent were

ligated. DeBakey and Simeone⁹ in their thorough review of the literature, and from study of statistics from World War II, concluded that it was of no value. Pemberton and McCaughan¹⁰ earlier (1932) believed that a positive Henle-Coenen sign (bleeding from the distal end of a severed artery) was an indication against ligation of the accompanying vein. If the sign was negative, the vein should be ligated attempting thereby to promote venous stasis and thus supply prolonged nourishment to the limb. It apparently does no harm to ligate the concomitant vein, and it may be a valuable protection against the danger of thrombi.

Other Procedures: Papaverine and whiskey are both valuable vasodilators. The dose of the former averages 1 grain every 3 to 5 hours, the latter 1 to 2 ounces every 3 to 4 hours. One or both should be used. In common with other cases of extensive trauma requiring debridement, these injury cases deserve the support and protection of a well padded, bi-valved cast. Keeping the limb at rest reduces its oxygen need, and theoretically, therefore, increases its chance of survival. The limb should be kept below heart level, as tending mechanically to promote vascularity. External heat should not be applied, because it increases oxygen need, the supply of which is already overburdened. Antibiotic and chemotherapy are essential routines.

Surgery of acutely thrombosed or embolic arteries partly parallels that of injured arteries. Treatment can be divided into more distinct phases, however, as described by Wetherell,¹⁸ and Barker, et al.³ The first, antispasmodics or vasodilators, particularly papaverine. The second, sympathetic block heparinization. The third, embolectomy. Improvement, with motion in the muscles of the affected extremity, is an indication for stopping treatment in the phase in which it is noted. The following is a report of a case for comparison with the cases of injury above.

A 76 year old white woman was admitted to the hospital with a history of acute onset of severe, cramping pain in her left leg below the knee, of one hour's duration. She had suffered from hypertensive heart disease for many years, and had survived one minor cerebral accident 2 years before. On admission the pain and cramping had subsided somewhat, but she had lost all motion of the leg, and could move the thigh only weakly. Examination was not remarkable except for generalized arteriosclerosis, an irregular pulse, moderately elevated blood pressure, and the condition of the left leg. The thigh was warm to the knee, and she could weakly flex the hip. Below the knee, however, the limb was pale, cold and entirely motionless, though she stated she could feel touch and had some cramping and pain. The muscles were firm and spastic. A lumbar sympathetic block produced no change, so 100 mg. of novocaine was given intraspinally in the third lumbar interspace. This produced no change except that the skin of the leg and thigh became

more mottled and blotchy. Six hours after onset, the femoral artery was explored under pontocaine spinal anesthesia. The femoral artery was incised just below the level of the profunda branch, and a large clot, extending upward toward the iliac and down past the profunda was removed. Bleeding was free after the clot was removed. The arterial incision was sutured with vaselined #5-0 silk eye suture, and heparin was injected intra-arterially, above the sutured site. The femoral vein was ligated and divided, and the artery stripped of the adventitia above the suture line. The patient was kept heparinized. Six hours postoperative the exploratory incision was oozing freely, and was opened for inspection. The artery was still pulsating well, but the whole operative site was oozing. Two hours later heparin was discontinued because the generalized oozing was worse. Color and motion in the limb was good at the conclusion of surgery, and continued to be good. By the fourth postoperative day the leg looked normal, had normal motion, and was only slightly edematous. The patient was out of bed on the fifth day. On the sixth day she suffered a cerebral hemiplegia involving the entire opposite side of the body. She expired five days later, having full use of the previously thrombosed leg until coma became complete in the last 36 hours of her life.

Motion of the affected limb here, as in the injured vessel extremity, should be the criterion for embolectomy. As long as the limb has motion, the circulation is adequate. Because of this, embolectomy (or arterial repair) is rarely indicated in the upper extremity. Conservative measures can be carried further in the thrombosed or embolic extremity than in the injured, particularly with heparin to prevent the extension of the process.

SUMMARY

1. Major vessel injuries of the leg are much more serious in a ratio of 4 to 1 than in the arm.
2. Collateral circulation will nearly always take care of axillary or brachial artery injury or blockage. Attempts to reestablish vessel continuity seemed to be harmful rather than beneficial in at least one case above.
3. Early debridement is essential. At least one arm was lost because of extensive hematoma formation with collateral circulation block. These cases should have highest evacuation and surgical priority.
4. Practically all war wounds of this type are complicated by compound fractures or other injuries, which distort the tabulation of results. Simple vessel injury should not result in so high a percentage as this of loss of limbs.
5. A simpler method of restoring major vessel continuity needs to be developed, for general use. A temporary measure which might

tide the circulatory damage over for a few days until the patient could be transferred to a vascular center would be of great value.

206 Church Street.

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Editor

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THE CARE OF SURFACE INJURIES OF THE HAND

The Fracture Committee of the American College of Surgeons has asked the Regional Committees to publicize their recommended treatment of hand injuries. The American Society for Surgery of the Hand prepared this outline, which contains more valuable information than most textbooks. Therefore, it is printed here in its entirety for the benefit of all who encounter such injuries:

I. The first-aid care of wounds of the hand is directed fundamentally at protection. It should provide protection from infection, from added injury, and from future disability and deformity. The best first-aid management consists in the application of a sterile protective dressing, a firm compression bandage and immobilization by splinting in the position of function. No attempt should be made to examine, cleanse, or treat the wound until operating room facilities are available.

II. Early definitive care requires thorough evaluation of the injury with respect to its cause, time of occurrence, status as regards infection, nature of first-aid treatment and appraisal of structural damage. For undertaking the definitive treatment the conditions

required are a well-equipped room, good lighting, adequate instruments, sufficient assistance, complete anesthesia and a bloodless field. The treatment itself consists of aseptic cleansing of the wound, removal of devitalized tissue and foreign material (exercising strict conservation of all viable tissue), complete hemostasis, and the repair of injured structures, to be followed by protective dressing to maintain the optimum position. After-treatment consists of protection, rest and elevation during healing, and early restoration of function by directed active motion.

III. Burns, abrasions and avulsions may cause destruction and denudation of any area of the skin of the hand. The care of such injuries has three major objectives:

1. Protection from infection.
2. Early restoration of skin covering.
3. Avoidance of disabling scarring and contractures.

These objectives are sought in the various stages of treatment.

1. First-aid treatment.

(a) Chemical burns.

Remove chemical by profuse irrigation with water, preferably warm.

(b) Heat burns, abrasions and chemical burns (after washing away the injuring agent).

Apply sterile dressing completely to cover the hand and bandage firmly.

2. Definitive treatment.

This should be carried on in operating room under conditions of strict asepsis. (Dressing of field, sterile gloves, masking of operator and attendants.)

(a) Gentle removal of first-aid dressing, soaking loose with normal saline solution if necessary.

(b) Gentle cleansing of injured surface by light sponging with saline on cotton balls. If surface is dirty or greasy, it may be gently cleansed with sterile neutral soap in sterile water or bland detergent. Loose fragments and tags of skin are removed. Blisters are not opened.

(c) Sterile strips of fine-mesh vaseline-impregnated gauze are smoothly applied to the injured surface. These are covered with dry sterile gauze, gauze being placed between adjacent fingers. The whole hand is covered with a thick layer of sterile mechanic's waste or fluff gauze, and splinted in the position of function. Elastic knit

bandage is applied over all, including all fingers, with firm, even pressure. The hand is kept elevated.

3. Subsequent dressings.

The original dressing is left undisturbed for 12 to 14 days unless elevation of temperature suggests active infection requiring inspection. The second, and all subsequent dressings until healing, are done under completely aseptic conditions (as described above). Preparations for skin grafting should be made in advance.

(a) The dressing is removed. Slough and debris are washed away by irrigation with normal saline solution (no scrubbing of surface).

(b) Granulating areas from which slough has separated should be covered with thin split-thickness skin grafts.

(c) Dressing, similar to that employed at first definitive treatment, is applied. Hand is splinted in position of function.

(d) Further dressings, similarly conducted, are done at intervals of seven days until epithelization of burned surface is complete. Skin coverage by grafting should be secured as rapidly as possible, as the best assurance against infection, inflammation, infiltration, scarring and contractures. This early coverage by "skin dressing" is of the greatest importance, even when epithelization from the margins is proceeding satisfactorily. Split-thickness grafts are best for this purpose, even though it is anticipated that some of grafted area must later be removed for replacement by more suitable skin.

4. Restoration of function.

As soon as epithelization of burned surfaces is complete, directed active use and exercise of the hand are begun. Normal use of the hand is encouraged and voluntary exercise and appropriate occupational therapy prescribed."

If these recommendations were followed in every emergency room, the incidence of permanent disability after hand injuries would decline much below present levels.

WALTER STUCK, M.D.

BOOK REVIEWS

The Editors of THE SOUTHERN SURGEON will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.

THE CLINICAL MANAGEMENT OF VARICOSE VEINS, by DAVID WOOLFOLK BARROW, M.D., Lexington, Ky. With a Foreword by ARTHUR W. ALLEN, M.D. Price, \$5.00. New York: Paul B. Hoeber, Inc., 1948.

This monograph is concise and easily used by both the general practitioner and the surgeon. The problem of varicose veins is covered with respect to pathology, physiology, and etiology. There is sufficient report on experimental data to allow a background for our present knowledge of these conditions. The presentation of the physiopathology is made, rather than a detailed discussion of individual symptomatology. An excellent summary of the detailed method of examination affords a picture as to which patients should receive various forms of therapy. In the discussion of treatment, the different sclerosing agents are given, presenting the advantages and disadvantages of each. The surgical treatment is well presented, which represents considerable experience. Complications and the prophylaxis are reviewed and presented in concise form. Numerous illustrations are made which afford a better understanding of the problems as well as adding much in the method of treating the condition. The references are complete and give an excellent background for one who is interested in reviewing further the problem.

J. D. M., JR.

AN INTRODUCTION TO GASTRO-ENTEROLOGY, by WALTER C. ALVAREZ, M.D., Professor of Medicine, University of Minnesota, The Mayo Foundation, and the Senior Consultant in the Division of Medicine, the Mayo Clinic; Author of *Nervousness, Indigestion and Pain*, 4th edition. Revised and enlarged, with 269 illustrations. Being the 4th edition of *The Mechanics of the Digestive Tract*. Price \$12.50. Published by Paul B. Hoeber, Inc., New York, 1948.

The fourth edition of *An Introduction to Gastroenterology* will be recognized by older readers as *The Mechanics of the Digestive Tract*, its original title and still a most descriptive one. Whatever its name, it is always pleasant reading, and the inquiring reader will find it profitable as well. This reviewer wishes particularly that those who are inclined to over-simplify digestive problems could peruse this book to discover what a wealth of information is available on digestive functions alone. Some of this information is theoretical, but in that case it is always identified as such, and its value is not in any way diminished by the fact that it has not yet been proved.

Readers of the older editions will find one hundred additional pages, exclusive of bibliography, since the third edition was published. This represents more than four hundred additions to the bibliography. As a matter of interest, the original bibliography contained only a small fraction of the source material used by the author today. I do not have a copy of the first edition for comparison, but the second contained only nine hundred titles in contrast to the twenty-eight hundred listed in the fourth edition. The author states that his editing and additions have been concentrated particularly on the chapters on the pylorus, the nerves running to the bowel, the nerves of the gallbladder, the

functions of the colon, flatulence, and electroenterogram, and technical methods and apparatus. Special attention has been paid to vagotomy because of its current prominence.

To those who have never read this work in any of its editions, I would urge an early reading. Even if careful study is not attempted, the reader will leave the book feeling wiser than when he approached it. Unfortunately, those who need it most are those most unlikely to take advantage of the opportunity—those who dismiss the gastrointestinal tract with a careless wave of the hand and who feel that laxatives and antacids provide an adequate armamentarium to deal with its disorders.

The purpose of a book review is not to say something nice about the book or its author, but I feel moved to close on a complimentary note. Dr. Alvarez has a knack of expressing himself in the simplest possible language. Fortified as he is by an ample vocabulary, his text is enhanced immensely by this practice, and the reader's attention is held without conscious effort because there is no necessity for mental translation. To me this is one of the most desirable qualities for technical writing, and cannot be praised too highly.

M. J.

